22500109049

3/634 11

J. Ashburton Thompson

TWENTY-SIXTH ANNUAL REPORT

OF

THE LOCAL GOVERNMENT BOARD,

1896–97.

SUPPLEMENT

CONTAINING THE

REPORT OF THE MEDICAL OFFICER

For 1896-97.

Presented to both Houses of Parliament by Command of Her Majesty.

LONDON:
PRINTED FOR HER MAJESTY'S STATIONERY OFFICE,
BY EYRE AND SPOTTISWOODE,
PRINTERS TO THE QUEEN'S MOST EXCELLENT MAJESTY.

And to be purchased, either directly or through any Bookseller, from
EYRE AND SPOTTISWOODE, EAST HARDING STREET, FLEET STREET, E.C., and
32, ABINGDON STREET, WESTMINSTER, S.W.; or
JOHN MENZIES & Co., 12, HANOVER STREET, EDINBURGH, and
90, WEST NILE STREET, GLASGOW; or
HODGES, FIGGIS, & Co., LIMITED, 104, GRAFTON STREET, DUBLIN.

1897.

[C.—8584.] *Price 4s. 8d.*.

7544

WELLCOME INSTITUTE
LIBRARY
Coll. welMOmec
Call
No. WA

PUBLIC HEALTH.

ANNUAL REPORT

OF THE

MEDICAL OFFICER

OF

THE LOCAL GOVERNMENT BOARD

FOR THE YEAR

1896-97.

E 97569. Wt. 3208.

Digitized by the Internet Archive
in 2021 with funding from
Wellcome Library

https://archive.org/details/s4644id1397441

CONTENTS.

APPENDIX A.—*cont.*

APPENDIX B.:

REPORT.

TO THE RIGHT HONOURABLE HENRY CHAPLIN, M.P., PRESIDENT OF THE LOCAL GOVERNMENT BOARD.

MEDICAL OFFICER'S REPORT.

SIR,

I BEG leave herewith to submit to you, for presentation to Parliament, my report on the proceedings of your Medical Department during the year 1896–97.

I.—Administrative Relations of the Medical Department.

1. VACCINATION AND PUBLIC VACCINATION.

In Appendix A., No. 1, will be found a summary of vaccination officers' returns, which relates to the condition as regards vaccination, on the 31st of January 1896, of 889,944 children whose births were returned to the Board as having been registered during the year 1894. Of these, 89,726, or 10·1 per cent., died before being vaccinated; 3,032, or 0·3 per cent., were certified to be "insusceptible" of vaccination; 29 had contracted small-pox before vaccination; 14,896, or 1·7 per cent., had their vaccination postponed under medical certificate; 156,135, or 17·5 per cent., could not be traced; and 626,126, or 70·4 per cent., were registered as having been successfully vaccinated. Both in the metropolis and in the provinces of England and Wales, the per-centage of births not finally accounted for as regards vaccination was higher for 1894 than it had been in any year since these returns commenced. It was 20·6 in the metropolis as contrasted with 5·7, the lowest per-centage recorded, namely, that for 1881; and it was 19·0 in the rest of England as contrasted with 3·8, the lowest per-centage recorded, namely, that for 1875.

INSPECTION OF PUBLIC VACCINATION.

During 1896, the number of unions inspected for the purposes of public vaccination was 299. These inspections involved 1,486 vaccination districts, and in 1,073 instances the work of the public vaccinators was reported to have been so carried out as to merit special award being made to the officers concerned. See Appendix A., No. 2.

EDUCATIONAL VACCINATION APPOINTMENTS.

On March 31st, 1896, the Board, by order, appointed George Shepley Page, L.R.C.S., L.R.C.P., to be a teacher and examiner at the Educational Station in Bristol, in succession to the late Henry Lawrence, M.R.C.S., L.R.C.P.; on June 5th, 1896, Francis Cadell, M.B., F.R.C.S., was similarly appointed to a new Educational Station which was established in Edinburgh to meet the increasing demands of the medical school in that city; and on November 13th, 1896, R. H. Henderson, M.B., was appointed to a like post in Glasgow, in succession to the late Hugh Thomson, M.D.

NATIONAL VACCINE ESTABLISHMENT.

During 1896, humanised lymph was issued from the National Vaccine Establishment in 6,289 capillary tubes; and calf lymph was sent out on 13,196 ivory points and in 91 capillary tubes. (Appendix A., No. 3.)

At the Animal Vaccine Station, vaccination was, as is the custom there, performed direct from calf to arm. (Appendix A., No. 4.) In the case of 5,810 primary vaccinations of persons who returned for inspection, the insertion-success ranged, in the hands of the several operators, from 90·53 to 98·58 per cent., and no case of insusceptibility was met with. Indeed, the Board now have record of 101,487 consecutive primary vaccinations performed by their own officers, among which no single instance of insusceptibility has been found. As already stated, 3,032 medical certificates of insusceptibility were granted in different parts of England and Wales, as regards children whose births were registered in the single year 1894, this year being the latest for which complete information on the subject is as yet available.

REPORT OF ROYAL COMMISSION ON VACCINATION.

In my last annual report I referred to the fact that although the final report of the Royal Commission on Vaccination, appointed on May 29th, 1889, had been received by the Board, a large amount of the evidence on which that report is based still remained to be issued. But, immediately on the issue of the report in September 1896, you decided not to await the complete issue of the evidence before taking that report into consideration, especially as regards such matters as might be dealt with by the Board apart from the question of fresh legislation. The result has been the issue by the Board of amended instructions to public vaccinators; and the institution of an inquiry in certain cities on the Continent of Europe, as to the procedures adopted in the preparation, storage, and distribution of calf lymph, especially in its glycerinated form.

INSTRUCTIONS TO PUBLIC VACCINATORS.

The amended instructions referred to were embodied in an Order dated 7th January 1897; and their issue had for its main object to indicate to public vaccinators that in the production of satisfactory results by the use of stored calf lymph they would stand in no different position, as regards the Board's approval of their work, than they formerly had done when producing similar results under the system which encouraged vaccination with fresh lymph direct from arm to arm. This Order, together with the new instructions, will be found in Appendix A., No. 5.

INQUIRY AS TO GLYCERINATED CALF-LYMPH.

Under your instructions, the inquiry into the procedures involved in the preparation of glycerinated calf lymph, and generally into the distribution of vaccine lymph derived from the calf, was undertaken by Dr. Monckton Copeman and myself, and visits for this purpose were made to Paris, Brussels, Berlin, Dresden, Cologne, and Geneva. I have already submitted to you in separate form our joint report on this subject, together with an introduction by myself; and the papers in question are reproduced in Appendix A., No. 6, of this volume.

2. Other Administrative Business of the Medical Department.

During the year 1896 a considerable number of conferences have been held at the office with local authorities and their officers in relation to such matters as the preparation and application of byelaws, the selection of sites for hospitals for infectious diseases, and the planning and construction of such hospitals. In the cases of Cheshunt, Deal, Folkestone, and St. Albans, it was deemed necessary that conferences as to local byelaws should be held in the districts concerned. Medical inspectors have also held local inquiries as to such matters as the formation of joint hospital districts, and the suitability of hospital sites or buildings in connexion with loans which it was desired to raise, in the following cases :—Aston Manor, Belper (Joint); Birkenhead; Birstall, Birkenshaw, and Drighlington (Joint); Blaby Rural and Wigston Magna Urban (Joint), Braintree Urban and Rural (Joint), Bridport, Bristol, Bucklow (Joint); Burnley (Joint), Conway (Joint), Coventry, Enfield, Farnham Rural, Folkestone, Gloucester, Goole; Guildford, and Godalming (Joint); Halstead, Hanwell (Joint), Hastings Urban, Hastings Rural, Hertford and Ware (Joint); Ilford; Keighley and Bingley (Joint), Lanchester (Joint), Leicester; Lewes Urban and Rural (Joint), Newcastle-on-Tyne, Paignton, Radcliffe, Richmond, Surrey (Joint), St. Helen's (Lancs), Sittingbourne and Milton (Joint), Southampton, Southgate, Stroud (Joint), Swindon (Joint—proposed purchase of hospital by County Council for Wiltshire), Thanet, Isle of (Joint), Tiverton (Joint), Tunbridge Wells, Uxbridge (Joint), Waterloo and Seaforth (Joint), Wath and North Rotherham (Joint), West Molesey, Whitchurch Rural, Wimbledon; Windermere and Bowness (Joint), Worcester, and Worcestershire County Council (Malvern hospital committee). Local inquiry was instituted into appeals made by local authorities against the inclusion of their districts within hospital schemes formulated by county councils in the cases of the Cowbridge Urban, Fylde Rural, Halesowen Rural, Pontardawe Rural, Upton-on-Severn Rural, and Wight, Isle of, Rural District Councils.

And further, local investigation was made by medical inspectors in connexion with proposals to raise loans as to the provision of a coroners' court, a mortuary, and a disinfecting station at Limehouse; of a building to serve as a reception house for persons in Southwark whose dwellings were undergoing disinfection; and of a disinfecting apparatus at Ilfracombe.

Inquiries were also made, with a view of determining how far it was necessary for the Board to issue Orders in reference to requiring local authorities to carry out public scavenging within the terms of section 42 of the Public Health Act, 1875, in the cases of Atherstone (Rural), Bakewell, Caterham and Oxted (Godstone Rural District), East Westmorland (Rural), Gildersome, Hemsworth (Rural), Leadgate, Pokesdown,

MEDICAL OFFICER'S REPORT,

Sedgefield (Rural), Thirsk (Rural), and Togston (Alnwick Rural District).

Detailed investigations were also made by medical inspectors into the occurrence of outbreaks of disease and into the efficiency of local sanitary administration in reference to the causation and prevention of the diseases concerned. (Appendix A., No. 7.) Reports on these investigations having been submitted to the Board, they were, in most cases, issued to the authorities of the districts involved. Thus, prevalences or occurrences of enteric fever were inquired into at Bicester (Oxon) by Dr. Thomson; at Chichester by Dr. Bulstrode; at Hucknall Torkard (Notts), and at Moggerhanger and Chalton (Beds) by Dr. Buchanan; and at Kessingland (Suffolk), at Middlesbrough, at Penrhynside (Carnarvon), and at Southend by Dr. Bruce Low. Enteric fever associated with diphtheria, formed the subject of inquiry at Chelmsford by Dr. Reece; an occurrence of the same two diseases and of measles was investigated at Lowestoft by Dr. Copeman; outbreaks of diphtheria came under investigation at Fulbeck (Notts) by Dr. Wheaton; at Gillingham (Kent), and at Ludgvan (Cornwall), by Dr. Sweeting; at Hatley Cockayne (Beds), by Dr. Buchanan; and also at Holywell (Flint), and at Huntingfield and Halesworth (Suffolk), by Dr. Mivart. Reports were made to the Board on inquiries into suspected bubonic plague in the port of London, by Dr. Buchanan; on the water supply of Long Buckby in Northamptonshire, by Dr. Bruce Low; on an occurrence of meat poisoning at Mansfield and its vicinity, by Dr. Buchanan; and on allegations affecting the administration of a hospital for infectious diseases belonging to the Sevenoaks Urban Council, by Dr. Bruce Low. Some of these reports are reproduced in Appendix A. to this volume. To these I now refer somewhat more in detail.

ENTERIC FEVER AT BICESTER.

In Appendix A., No. 8, will be found a report by Dr. Theodore Thomson on an outbreak of enteric fever in the small market town of Bicester. The town, which has some 3,000 inhabitants, had for years past exhibited a "fever" death-rate in excess of that which obtained throughout England and Wales as a whole, and 56 attacks are known to have taken place there in 1890. A few attacks and one death from enteric fever were recorded between May and August 1895; five "suspected" cases were found to have occurred in September; and between the end of October and the middle of November a substantial outbreak of 28 well-marked cases took place. The disease was, as had also been the case in 1890, all but limited to the northern end of the town; and in 90 per cent. of the cases in this outbreak, those attacked were ascertained to have used water from the Crockwell spring. Indeed, the only attacks which took place outside the infected area to the north of the town occurred in persons who sent for this water from a distance, owing to its local reputation. When the surroundings of the Crockwell spring came to be investigated,

it was found to be in close proximity to the junction of two of the public sewers, the junction having been so contrived as to ensure free leakage of their contents into the surrounding soil. The spring was closed on October 25th. But the disease continued, and a second batch of cases took place in the fortnight ending December 7th. These cases were 10 in number; and of these 10, seven resorted to the Plough Terrace well, whilst two of the remaining three had opportunities of contracting the disease from antecedent cases. This Plough Terrace well was in a yard within the comparatively small limits of the infected area; and it was in dangerous proximity to sources of gross pollution. It was closed on December 2nd. No further attacks took place until the week ending December 21st, but between then and January 4th, 1896, another batch of 11 cases occurred within the same area of the town. This time seven of those attacked were found to be consumers of water from Woodcock's well, into which the contents of a drain were seen to be leaking freely. Woodcock's well was closed on January 3rd, but between then and the 17th, two more persons who used it had fallen sick of enteric fever. After this, seven more attacks took place at intervals up to the end of March, five of them occurring in houses supplied from a spring which, besides other means of pollution, was found to be situated within 30 feet of a sewer known sometime back to have been silted up, and leaking at many points.

In recording this story, Dr. Thomson is able to eliminate, as causes of the outbreak, the numerous other unhealthy conditions of Bicester, and also its milk supply; for all these applied equally to the whole town. The localisation of the disease could only be accounted for by the use of the local wells and springs referred to; the water from which, being derived from porous and fissured strata which were at all times liable to soakage of filth, served from time to time as a vehicle for distributing the specific filth derived from the excreta of enteric fever.

It must not be assumed that the danger of thus suffering water-bearing strata to become polluted, and of allowing them to continue to serve as a source of water supply for a community involved a risk of which the local sanitary authority were in ignorance. Far from it. After the outbreak of 1890, their Medical Officer of Health reported to them that "a safe water "supply for the district is essential"; and a resolution was at once passed to carry out the recommendation. But in the meantime the fever had abated; and Dr. Thomson reported in May 1896 that the same subject was then, after an interval of about six years, once again in the stage of discussions and resolutions.

Unfortunately, Bicester is not alone amongst old market and other towns which stand upon a soil the surface of which has been inhabited for many years, and the interstices of which whilst serving, in one and another way, to receive the percolations of neighbouring filth, also furnish the domestic water

supply. A seeming impunity often attaches to long maintained neglect of this sort; but the introduction of a specific poison into a soil thus polluted has often served to show, as at Bicester, how grave a danger there is in first ignoring the risk involved, and then in putting off the remedy.

ENTERIC FEVER AT CHICHESTER.

The city of Chichester, with a population now estimated at about 10,800, has long had an unfavourable reputation with regard to enteric fever. The late Dr. Seaton, before his appointment as Medical Officer to the Board, reported in 1865 to the effect that diseases such as "gastric, enteric, or typhoid fever are never "long absent, and sometimes considerably prevail in this city"; and he specified certain localities where the disease tended both to prevail and constantly to recur. The city was further inspected on behalf of the Board by Dr. Hubert Airy in 1879 on account of enteric fever which, at that date, was mainly being distributed through the agency of infected milk. During the 20 years 1871–90, the death-rate from enteric fever and continued fever in Chichester has been far in excess of that prevailing in the county of Sussex as a whole, or in England and Wales. When, therefore, the Board received information in the autumn of 1896 of a fresh prevalence of the disease, Dr. Bulstrode was instructed to inquire into the circumstances under which it had arisen, and his report is contained in Appendix A., No. 9.

According to that report 111 cases of fever were notified in Chichester between April and September 1896, the bulk of the attacks taking place in July and August. In all, 76 houses were invaded; with four exceptions they were all situated outside the city walls; and most of the streets and areas in which the disease occurred were the same as those which had been attacked when Dr. Seaton reported on the city 30 years ago. Indeed, to quote Dr. Bulstrode, "the localities "mainly invaded during 1896 were those which have been "repeatedly invaded in former years." No explanation of this fever prevalence could be found in one or other of the conditions with which the causation or spread of the disease is now more commonly identified. Many of the houses in Chichester are still provided with privy-pits and cesspools situated within their curtilage; in the case of many more, however, the drains have been connected with a recently constructed system of sewers, and this system, in the minds of some persons, was concerned with the fever prevalence. But of the 76 invaded houses 50 were "undrained," and only 26 were "drained," whilst of the 682 houses inside the city walls only one "drained" house was invaded. It became clear that milk had, on this occasion, not served as a vehicle of the infection. So also the conditions of water supply failed to explain the localisation or the distribution of the disease. Out of a total of 2,722 houses in the city, 1,393 were supplied by the Waterworks Company from a well sunk into the chalk marl and chalk, and 37 only of the 76 invaded houses received this water; whereas

of the remaining 1,329 houses deriving their water from local wells 39 were invaded. Whilst no suspicion could attach to the water from the Company's well, the local wells were found to be sunk amidst privy-pits and cesspools, and yet the incidence of the fever on one class of house was practically the same as on the other, namely, 2·6 per cent. on the houses receiving the Company's water, and 2·9 per cent. on the houses supplied by private wells. There remained, however, the fact that, with all the changes and improvements which Chichester has undergone during the last 30 years, the condition of the soil has remained persistently foul. Privies and cesspools have all along contributed by soakage to infiltrate a gravelly superficial soil with filth; even where, under the new system of drainage, these filth receptacles have become disused, they have, in not a few instances, been simply filled up, instead of being cleaned out; and to quote Dr. Bulstrode, "it would seem that the whole gravel "upon which Chichester is built is riddled with them." When, therefore, in May and June 1896, a few cases of enteric fever cropped up in one and another of these notoriously insanitary areas outside the city walls, where enteric fever had often prevailed before, a steady diffusion of the disease soon set in. Indeed, this prevalence of fever presents several points which are of especial interest at the present time. It goes to show that enteric fever, though mainly distributed in epidemic form by means of water or of milk, is by no means always a "water-borne" disease; and it raises anew the question as to how far recurring prevalences of enteric fever in one town or spot can be due to the persistence in more or less active form in certain soils of the organism of that disease. This question has, for some time past, been deemed in the Medical Department to be one deserving of more careful study than had hitherto been bestowed upon it; and hence I sought your sanction last year to an initial investigation into this subject, and I am now able in Appendix B., No. 2, to submit a first report by Dr. Sidney Martin on his studies as to the behaviour of the typhoid bacillus in one and another soil, including soils sent by Dr. Bulstrode, from "fever areas" in Chichester. I shall, further on, refer to some important facts which Dr. Martin has already ascertained.

Bearing upon the question of the persistence and the periodic recurrence of enteric fever in certain areas of England and Wales, Dr. Bulstrode prepared, in connexion with his inquiry at Chichester, a chart and three maps which may usefully serve to indicate that whilst enteric fever has been undergoing enormous diminution in this country, the areas of both its maximum and its minimum incidences have remained practically the same during the 20 years 1871–90, which have witnessed such great improvements in the sanitary circumstances of our towns and villages.

The chart and maps which follow immediately on Appendix A., No. 9, relate to deaths registered as due to enteric fever and continued fever. The chart shows, amongst other things, that

whereas this fever death-rate in England and Wales was 43 per 100,000 living during the decennium 1871–80, it had fallen to nearly half, namely, 22 per 100,000, during the decennium 1881–90.

The rate of 43 for the first decennium dealt with was made up of mortalities for different registration counties, ranging, per 100,000, from 73 in Durham, 59 in the West Riding of Yorkshire, 58 in South Wales, and 50 and upwards for the other Ridings of Yorkshire, Lancashire, Nottinghamshire, and Northumberland on the one hand, down to an average of 25 for the combined counties of Surrey, Dorset, and Sussex on the other hand. In the second decennium Durham still occupied the position of unenviable precedence; next followed the other counties which exhibited excess of death from this cause during 1871–80, the West Riding of Yorkshire, however, taking the eighth instead of the second place. On the other hand, the counties of Surrey, Dorset, and Sussex, in combination, still held one of the lowest places in the scale of this fever mortality, but had been surpassed in the matter of a small death-rate by Rutland, Bedfordshire, and Herefordshire.

Comparison between Maps No. 1 and No. 2 shows the dimunition referred to in a very striking manner. In Map No. 1, relating to 1871–80, the rates on different counties are indicated by five sets of colour; in Map No. 2, relating to 1881–90, only two of these colours remain, the three which have altogether disappeared being those indicating the higher rates of death. In Map No. 3 comparison is made of the different death-rates from enteric and continued fever in English registration counties during 1881–90.

These facts go to indicate the need for systematic study of a question which has gradually come to acquire considerable importance, and which may be put thus:—What are the local conditions by reason of which certain areas, whether registration counties, towns, or villages, have, for at least a generation, become identified with such persistence or periodic recrudescence of enteric fever, as has continued to secure for them death rates from that disease in excess of other districts, with some at least of which they may not unfairly be compared?

Already there are indications which serve to show that whilst much of the diminution in enteric fever has gone hand-in-hand with the abandonment of water services which, being subject to receive specific pollution, served for wide diffusions and sudden outbursts of enteric fever,—much of the persistent prevalence of that disease is associated with those systems for the disposal of excreta and refuse which still find favour in certain parts of this country, and which inevitably involve organic pollution of the soil. But the subject calls for much more study, both in its practical and scientific aspects; and this the more so since diminution, for the country as a whole, in the death-rate of this typically preventable disease would seem to be coming to a standstill.

MEDICAL OFFICER'S REPORT.

In Appendix A., No. 10, will be found a report by Dr. Sweeting on a prevalence of diphtheria in the Gillingham urban district. The report is reproduced with a view of drawing attention to the circumstances which should govern the action of a medical officer of health in restricting attendances at elementary schools with a view of preventing the spread of disease. Under Article 88 of the Code of Regulations issued by the Lords of the Committee of Council on Education it is laid down that: "The managers must at once comply with any " notice of the sanitary authority of the district in which the " school is situated, or any two members thereof, acting on the " advice of the medical officer of health, requiring them for a " specified time, with a view to preventing the spread of disease, " or any danger to health likely to arise from the condition of " the school, either to close the school or to exclude any scholars " from attendance, but after complying they may appeal to the " department if they consider the notice to be unreasonable."

It is also prescribed in Article 83 (*a*) that: "If a school has " been closed during the year under medical authority, or for " any unavoidable cause, a corresponding reduction is made " from the number of meetings" required. And further, it is provided in Article 101, that where the Education Department " are satisfied that by reason of a notice of the sanitary authority " under Article 88 . . . . the average attendance " has been diminished, and that consequently a loss of annual " grant would, but for this article, be incurred, the department " have power to make a special grant not exceeding the amount " of such loss in addition to the ordinary grant."

Complaints relating to this subject not infrequently come under the notice of the Board. They are mostly of one or other of two sorts. In the first place complaint is made that the advice of the medical officer of health as to the closure of a school or as to the exclusion from school of children from particular houses or localities has been disregarded by the school managers acting as education authority; and, in the second place, education authorities who have complied with the advice of the medical officer of health in this matter, complain that they have found themselves debarred from a special grant, to make up for the diminution of their average attendance, by reason of the fact that the form in which the advice or instruction as to restricting the school attendances had been given, was not in accordance with the provisions of the Education Code. Dr. Sweeting's report is typical of the circumstances which give rise to such complaints, and it shows the difficulties in which a medical officer of health may be placed by reason of his taking action other than that which is laid down in the Code.

Several schools came in question in Gillingham, but I propose in the main to limit my comments to the Byron Road Board School under the administration of the Gillingham and Grange

School Board. That school was first closed for a period of a fortnight from June 2nd as the result of a verbal intimation by the medical officer of health to the chairman of the School Board; this action being adopted owing to a special incidence of diphtheria on the children attending it. Before the expiration of a fortnight the medical officer of health attended a meeting of the School Board, and later on he had an interview with the clerk to that board, as the result of which it is alleged that he declined to assent to the re-opening of the school, but expressed a hope that school operations might be resumed on July 6th. But on June 25th, the School Board met and passed a resolution in which they set out that they had received no additional report from the medical officer of health, and that they considered "the further closing to be unreasonable"; a resolution which was locally held to amount to a "vote of censure" on that officer. This so-called vote of censure was however rescinded at a special meeting on July 3rd; and, as matter of fact, the school did remain closed until July 6th. Three days afterwards the School Board, at their ordinary meeting on July 9th, ordered a letter to be sent to the Gillingham Urban District Council asking that council to furnish the School Board with lists of children suffering from infectious disease, so that steps might be taken to exclude them from school.

It will thus be seen that no notice was at any time issued by the district council, acting as a sanitary authority, or by any two of their members, acting on the advice of the medical officer of health, as to the closing of the Byron Road School; and that the medical officer of health, in taking upon himself to deal officially and in person with the chairman and clerk of the school board, as to restrictions on school attendances, laid himself open to have his personal relations with the school board discussed, and to have his action criticised adversely by members of that body, who were presumably not aware of the medical considerations by which his advice was governed. So also, the fact of the medical officer of health having thus placed himself in these personal and official relations with the officials of the school board naturally led that board to assume that they had a right to be supplied with information in his possession, and which they regarded as helpful or necessary to them in the performance of their duties in relation to elementary education. And not only so, but since no closure of the school was effected, by reason of a definite notice such as is indicated in Articles 88 and 101 of the Code, the managers ran considerable risk, in having acted solely on the personal advice of the health officer, of incurring loss in the amount of their annual grant.

It cannot be too clearly understood that it is the local sanitary authority, and not the medical officer of health, who can require the managers to restrict attendances at elementary

schools by way of closure or exclusion of particular scholars; that the official duty of the medical officer of health is in this matter limited to that of tendering advice to the sanitary authority; and that an order issued by the sanitary authority as to either one or other measure of restriction must be for a specified time. With a view of indicating more cleary the attitude to be adopted by medical officers of health in this matter, the memorandum dealing with this subject, which has for some years past been issued by the Board, has, after consultation with the Education Department, been revised, and the re-issue will be found in Appendix A., No. 15.

Meat Poisoning at Mansfield.

An outbreak of illness which occurred in and around the borough of Mansfield in February, 1896, and which was referred to the consumption of a particular "potted meat," sold locally on February 12th, and on three following days, is reported on in Appendix A., No. 11. Dr. G. S. Buchanan, who was instructed to inquire into this outbreak, found that the sample of "potted meat" in question had been in almost all cases poisonous to persons consuming it. Of a total of 279 such persons as many as 265 were attacked. The induced illness had a character similar to that which has been observed in other outbreaks of "food poisoning." After a period of latency which varied in different individuals from 5 hours to 48 hours, the consumers of this "potted meat" suffered from acute stomach and bowel disturbance, accompanied in many instances by fever and by sundry nervous symptoms. The illness of particular individuals lasted only two or three days, but in many persons its duration was a week or more. Happily no deaths occurred.

The implicated "potted meat," about 1 cwt., had been prepared on February 11th by a Mansfield butcher. The principal ingredients seem to have been beef and pork, which apparently were not in themselves unwholesome. These materials were first cooked with water in a boiler; and it is believed they were actually boiled. After cooling, they were minced and otherwise "made up." The produce was coloured with a red pigment, a coal tar product which by itself would seem to have been innocuous. After reviewing the facts which he was able to obtain with regard to the manufacture of this "potted meat," Dr. Buchanan found reason to believe that some deleterious agent had gained access to the material subsequent to cooking, and in the course of "making up." Now the clinical characters of the induced illness did not warrant the assumption that this deleterious agent had been any mineral poison; the facts on the other hand were consistent with the "potted meat" having contained certain micro-organisms capable of elaborating poisonous products, either in the material before it reached the consumer, or in the human alimentary tract when introduced there along with the potted meat. Dr. Buchanan failed to trace any mineral poison to the preparation, and also he failed to obtain evidence of the addition, purposely or

accidentally, of any single compromising ingredient likely to contain noxious microbes. He found, however, that the preparation of this Mansfield "potted meat," like that of certain meat stuffs which have been responsible for other and similar outbreaks of poisoning, had been attended by conspicuous lack of cleanliness. Thus, the whole manufacture was carried out in a room which formed the habitual pig slaughter-house of the butcher's establishment. In this room it was customary for carcases of pigs to be scraped and washed over boilers which at other times were used for cooking meat for potting and similar food compounds; receptacles and utensils used for the preparation and storage of the "potted meat" were dirty; and certain of these utensils were employed in the dressing of carcases as well as in the manufacture of cooked meat. Such uncleanly conditions as these appear to have afforded opportunities of contamination with diverse matters which may be considered likely to convey microbes capable of imparting a poisonous property to the preparation.

Certain specimens of the "potted meat," which, however, could not be procured until several days after its manufacture, were submitted to Dr. Klein for bacteriological examination. Dr. Klein did not find in these specimens any microbe, possessing specifically infective properties, such as he had previously demonstrated in other food materials which had been similarly poisonous. The samples proved indeed to contain, almost exclusively, and in remarkable abundance, two common saprophytic microbes: bacillus coli and bacillus proteus. So exceptional was the number of these organisms present in the specimens that Dr. Klein has been led to consider the question whether, in the circumstances, the poisonous properties of this "potted meat" might not have resulted from mere abundance and extra activity of these reputedly harmless microbes.

BUBONIC PLAGUE.

Amongst the papers which I submit in Appendix A., is a report, No. 12, on an inquiry by Dr. G. S. Buchanan as to one or more cases suspected to be bubonic plague which occurred in the port of London in the autumn of 1896. The immediate cause of Dr. Buchanan's inquiry was the occurrence of a case of illness which terminated fatally in the Branch Seamen's Hospital; the patient being a Goanese "knifeman," or steward's helper, who joined a steamship at Bombay on August 20th. This steamship, which reached one of the docks in the port of London on September 11th, carried 199 hands, 119 passengers, and a general cargo. The patient sickened, as nearly as could be ascertained, on or about September 26th; on September 29th he became seriously ill, and was removed to hospital with gradually developing symptoms strongly suspicious of bubonic plague; and he died on October 3rd. Specimens of material from the enlarged glands in the right groin were examined at the British Institute of Preventive Medicine, and the bacillus of bubonic plague was isolated and cultivated. A subculture

having been courteously supplied to me, it was examined for the Board by Dr. Klein, who reported that it coincided in every respect with the typical plague bacillus. See Appendix B., No. 7.

During inquiry into this case, the occurrence of a previous fatal attack of illness in another Goanese "knifeman" on board the same steamship was heard of, the patient having been discovered, after a few days of minor sickness, to be seriously ill on September 27th, immediately antecedent to the onset of definite symptoms in his colleague. He died on board ship the same day, and the clinical features of his malady were ascertained to have closely resembled those of his fellow-countryman.

So far as can be judged, the onset of the more definite symptoms in these two cases occurred not less than 15 days after arrival of the steamship in dock, and they followed on a voyage during which no suspicious case of illness had occurred. The period of incubation of plague is commonly from three to six days; and even granting that it may exceptionally be prolonged to nine days, it would still be obvious that these two Goanese must have received their infection some time after they reached the port of London on September 11th. The source of this infection was made the subject of careful inquiry, and there seems but little doubt that it was conveyed by means of clothing or other personal belongings which had been stowed away in one or other of the men's chests at Bombay, and not brought out until after arrival in dock. The bunks allotted to these two men were in juxtaposition; only one other man, who remained well, occupying the same cabin.

When this occurrence came under investigation it was further ascertained that a man employed as fireman on board another steamship had died within a few hours of admission into the Branch Seamen's Hospital on September 19th; the steamship having reached the Thames from Calcutta on September 7th. In this case, also, fever with enlargement of the glands in the groin had been prominent symptoms. Beyond these facts, nothing confirmatory of the nature of the disease from which the man suffered could be elicited. But such partial history as was obtained seemed to indicate clearly that there was no connexion between this man's illness and the attacks of the two Goanese stewards' helpers on board the other vessel.

Thus there occurred in the Thames port, in the autumn of 1896, three fatal cases of disease having more or less close clinical resemblance to bubonic plague. In one of the cases there was definite bacteriological evidence that the disease was plague; and in a second case occurring on board the same vessel, the circumstances fully justified the belief that the same disease was in question. The attack, which was first in point of date, took place, like the two previously referred to, in one of a crew recently arrived from India, and the limited information procurable concerning the patient shows the case, to say the least, to have been a suspicious one.

MEDICAL OFFICER'S REPORT.

REPEAL OF QUARANTINE ACTS.

All three attacks took place at a somewhat significant period of English sanitary history, namely a few weeks after the passing of the Public Health Act, 1896, under which the last vestige of law relating to quarantine in the United Kingdom was repealed. The actual repeal, though enacted on August 7th, 1896, did not come into operation until after the lapse of an interval of three months, namely, on November 9th, 1896; and under these circumstances plague nominally remained during September to be dealt with under the quarantine law. But, as had long been the case with regard to the few remaining quarantinable diseases, the action necessary to the control of the infection was taken by the local sanitary authority; in this case the Port of London Sanitary Authority. Directly Dr. Collingridge, the port medical officer of health, had suspicion of the existence of plague within the port district, every practicable measure as to cleansing and disinfection was taken as regards vessels, clothing, &c.; the crews on board ships lying in the docks were systematically inspected; information as to the health of those who had left the particular ships for their homes was sought for; and, with the assistance of the medical officers of health, both for the county of London and for other districts riparian to the Thames, inquiries were instituted as to the existence of any other case or cases on shore or afloat in any way resembling plague. No such cases were heard of, and no spread of the disease took place.

REGULATIONS AS TO CHOLERA, YELLOW FEVER, AND PLAGUE.

As already stated, the remaining quarantine laws of the United Kingdom were finally repealed in 1896; and the duty of dealing with the quarantinable diseases, yellow fever and plague, was definitely transferred to the Local Government Board and the local sanitary authorities. This necessitated the issue by the Board of Regulations made in pursuance of section 130 of the Public Health Act, 1875. Consequently the Board issued, on the 9th of November 1896, an Order relating to cholera, yellow fever, and plague, which embodied regulations adapted to all three diseases. A copy of this Order and of the regulations will be found in Appendix A., No. 13.

RESCINDING ORDER AS TO DIRTY BEDDING, &C.

Owing to the prevalence of cholera in a number of European and other states, the Board issued an Order, on August 5th, 1893, forbidding the delivery overside, in any port or place in England and Wales, of dirty bedding, or disused or filthy clothing, from certain foreign ports, except for the purposes of disinfection or destruction; and a further Interpreting Order, dealing with the same subject, was issued on September 13th, 1893. Both these Orders were cancelled by the issue of a Rescinding Order, dated 21st December 1896, which is printed as Appendix A., No. 14.

RETURNS OF NOTIFIED INFECTIOUS DISEASES.

The returns of notified attacks of infectious diseases in sanitary districts, where the number of attacks can be compared with the deaths registered quarter by quarter from the corresponding causes, will be found in Appendix A., Nos. 16 and 16(a). For the sanitary districts comprised within the metropolis the same data are recorded also weekly.

II.—Cholera Prevalences.

I am able to report that during the year 1896–97, as in previous recent years, no case of cholera occurred in England and Wales. Four attacks that were locally deemed to be suspicious were inquired into; but they were found not to be true cholera, and this opinion was confirmed as the result of bacteriological study. Seven vessels which were held to be "infected" with cholera, as that term is defined under the Board's Order, reached English ports during the year. Precautionary measures, including cleansing and disinfection, were adopted, and no recurrence of the disease took place.

Russia was finally declared to be free from cholera on February 12th, 1896. In Egypt, the epidemic of cholera which followed on the importation of that disease in 1895, was maintained throughout the greater part of 1896. The statistics of this epidemic are as yet incomplete; but between October 12th, 1895, and October 31st, 1896, the number of cholera deaths recorded reached 18,105.

III.—Auxiliary Scientific Investigations.

Epidemicity in Biological Aspects.

It is a proposition which long since commended itself to the epidemiologist in his capacity as a field-observer of the behaviour of epidemics, that the epidemicity of certain infectious diseases, more especially those the infection of which is apt to be water-borne, may be governed by conditions independent of the human subject. Again and again, for instance, the epidemiologist has found reason for suspecting that in earth or in water the microbes of cholera and of enteric fever are subject to conditions which at one time enhance, at another time destroy, their virulence and their ability for reproducing their kind. But speculation of this sort has hitherto obtained little encouragement from the labours of the bacteriologist; there has rather been a discouragement, since, under laboratory conditions, the microbes of one and another disease have generally been found remarkably stable not only morphologically but pathogenically. Wherefore some recent observations of Dr. Klein in the course of his investigation—undertaken in connexion with the Board's inquiry respecting "Oyster culture in relation to disease"—of the ability of the oyster to serve as a multiplying ground for the living organised poison of one and another "water-borne" disease, are of the greater interest and importance.

Dr. Klein noted that Koch's cholera vibrio when added to sea water contained in tanks wherein oysters were experimentally stored for a greater or less number of days, was prone to morphological change. And further he discovered that in the interior of the oyster itself not only did Koch's cholera vibrio become so quickly and profoundly modified as to be scarcely recognisable culturally and physiologically as the vibrio with which the experiment was started but also that

the descendants of the modified vibrio inherited in all respects the features and qualities of their anomalous parent.

In these circumstances it was determined that Dr. Klein should make further study in detail of Koch's cholera vibrio under conditions, in *water media*, which had been found to modify that microbe in the sense above indicated; and that, conversely, he should seek to ascertain, by retrograde steps as it were, whether this profoundly modified micro-organism may not be made to revert again, as regards form, cultural behaviour, and virulence, to the condition of the true cholera vibrio from which in the course of the experiment it had been derived. Meanwhile, Dr. Sidney Martin was instructed to make observation on parallel lines, and *with soil as a medium*, of the typhoid bacillus, with the object of ascertaining, under differing conditions as regards temperature, moisture, and organic constituents, what soils tend to conserve and enhance, and what soils tend to destroy and discount, the life processes and physiological activities of this reputed agent of enteric fever.

CHOLERA MICROBE.

In Appendix B., No. 1, Dr. Klein records his further observation of the mutability of the cholera microbe. The several varieties of this microbe which he isolated in the course of his oyster investigations, as well as certain other varieties obtained in like way, have now been closely studied by him during 12 consecutive months. And he finds, as before, that external to the animal body, and under conditions as diverse as practicable from those commonly employed in the laboratory for the purpose of conserving microbes, Koch's vibrio is extremely prone to sudden modification; and that the several varieties of that microbe thus set up retain thereafter with great persistence each its own individual characteristics. By no conditions that Dr. Klein could contrive in the laboratory was he able to induce any one of his varieties to revert to its original type, or, indeed, to vary further atypically. These results, as need hardly be pointed out, are in entire harmony with the facts respecting the behaviour, as a disease, of cholera in this and other European countries. For many years we have regarded the cause of cholera as particulate—as an exotic microbe, indeed, which outside the animal body, and in this country, has no great tendency to "breed true," or is at least prone to part soon with its virulence. Accordingly in practice our measures in repression of cholera have been so to deal with the invaded locality as to prevent, or at least discourage, in earth or in water, acclimatisation of any foreign microbe upon which cholera may depend. It is satisfactory, therefore, to find our principles and practice in this matter fortified by the result of researches such as those of Dr. Klein.

TYPHOID BACILLUS.

Dr. Martin's investigations of the behaviour of the typhoid bacillus in soil (Appendix B., No. 2) tend in like manner to justify our precautions past and present in the matter of enteric fever. In dealing with indigenous disease, it has been our

object to secure the earth within our towns and villages against fæcal pollution; not only because foul matters getting access to the soil are apt to pass thence into water supplies, but also for the reason that, as already indicated, we have come to suspect organically polluted earth as constituting an especially favourable nidus for the multiplication and elaboration of the typhoid bacillus. Dr. Martin's testing of the question submitted to him has not yet advanced beyond a preliminary stage, but already he has ascertained that the behaviour of this microbe is very different when, in the absence of competing micro-organisms, it is implanted in organically polluted soil, and in soil from an altogether uninhabited and uncultivated area. In soil of the former sort, as, for instance, in samples of earth from Chichester, the typhoid bacillus speedily increased and spread abroad, whereas in the virgin soil under like conditions of temperature and moisture, it languished and quickly died out. Dr. Martin's researches in this connexion are still proceeding.

BEHAVIOUR OF THE TYPHOID BACILLUS IN MILK.

In "milk epidemics," whether of enteric fever, scarlatina, or diphtheria, indication has now and again been forthcoming that infection of the disease current in a particular outbreak has, subsequent to gaining access to milk, multiplied therein before and after delivery of such milk to customers of the implicated dairy. Nothing is, however, with certainty known of the conditions which favour, or which are antagonistic to, multiplication in milk of one and another infection, though it has been surmised that certain of the numerous bacteria apt to be present normally in milk may have an important influence on the life processes of disease microbes that happen to obtain access to that fluid. With a view, therefore, to procuring knowledge on this subject, Dr. Cautley was instructed (Appendix B., No. 3) to ascertain which of the bacteria ordinarily to be found, or abnormally present, in milk, tend to render that medium a multiplying ground for the typhoid bacillus.

Dr. Cautley has not been so fortunate as to obtain, among the numerous samples of every-day milk with which he experimented during several successive months, any one sample in which the typhoid bacillus conspicuously multiplied; so that thus far his primary object was not attained. Nevertheless he has ascertained that this bacillus can persist, though diminishing rapidly in number, many days in milk under the conditions in which it is delivered to and retained in households, and that it can be recovered in viable condition even though the "kept" milk has turned sour. Incidentally he found that the micro-organisms commonly present in milk, though always extremely numerous, varied in abundance with the season of the year; and that in winter, when they were least abundant, the typhoid bacillus, after addition to milk, survived longest. Acting on this suggestion, he ascertained that in sterile milk, in the absence, that is, of a plurality of different competing micro-organisms, the typhoid bacillus not only persisted, but even multiplied considerably. In sterile milk, in association with only a single

MEDICAL OFFICER'S REPORT.

competitor—as, for instance, bacillus lactis, oïdium lactis, or yeast—the typhoid bacillus was little hindered in its life processes. But none of these micro-organisms was found to actually facilitate its multiplication in that medium.

ANAËROBIC BACTERIA.

The discovery in 1895–96, by Dr. Klein, of an anaërobic bacillus in the bowel discharges of a number of persons suffering simultaneously from severe diarrhœa, raised some important considerations. The microbe in question was found by him to be abundantly present not only in the dejecta of the sick persons, but also in samples of the milk which had formed part of their diet; and the circumstances were altogether consistent with this bacillus having been the cause of their illness. Hitherto, as I pointed out in my report for last year, bacteria of this class, *i.e.*, microbes which subsist and carry on their life processes independently of free oxygen, have not been studied, nor even suspected, in this connexion; and accordingly Dr. Andrewes was instructed to undertake investigation of the anaërobic microbes discoverable in the human alimentary canal in health and in disease.

Dr. Andrewes' work (Appendix B., No. 4) in the above direction has proved distinctly helpful towards understanding the causes of diarrhœa. He has obtained presumption, for instance, that anaërobic bacteria are not commonly inhabitants of the healthy human intestine, and he is able to show that they are not usually present in the dejecta of persons suffering casual diarrhœa. We are in the better position, therefore, to go on to inquire as to the concern of anaërobic microbes, such as *bacillus enteritidis sporogenes*, in the exceptional—that is, the epidemic—diarrhœa of this country.

SCARLATINA "RETURN CASES."

Reappearance of scarlatina in households shortly after the return to them of persons who have been treated for that disease in hospital, and notwithstanding much care exercised on the part of hospital authorities in guarding against the discharge from their establishments of persons whilst still in an infectious condition, has made it evident that there occur now and again cases in which persons who have seemingly completely recovered from scarlatina are nevertheless for a great number of weeks capable of infecting others. Upon this fact I commented in my report for 1894–95, as also upon some of the administrative difficulties arising therefrom; and as a result Dr. Klein received instructions to ascertain, if possible, in what sense these persistently infective persons differ from ordinary scarlatina convalescents, and especially how they may be distinguished from such patients.

Dr. Klein's investigation of this problem (Appendix B., No. 5) has, as was foreseen, proved both difficult and tedious. As a preliminary procedure, it has involved exhaustive study bacteriologically of the desquamating skin of persons at various stages of their recovery from scarlatina; and this because of the very common belief that those scarlatina convalescents are in the

main dangerous who, after apparent complete recovery, commence again to shed their cuticle, to "peel," as it is termed, a second time. This belief had long been doubted in the Medical Department, and Dr. Klein has not, so far as his investigation has gone, found any justification for it. At no stage of the peeling process after scarlatina has he detected in the cast-off cuticle any microbe which can be thought of as having concern in spreading the disease. And the like is true for the urine of scarlatina convalescents. Dr. Klein is proceeding, in due course, with investigation of the throat secretions, and of the nasal and aural discharges, of persons in the convalescent and post-convalescent stages of scarlatina.

MEDICAL OFFICER'S REPORT.

VACCINIA AND VARIOLA.

Dr. Copeman, following up, in scanty intervals of leisure, the attempt, commenced by him antecedent to his appointment as medical inspector, to manufacture vaccine lymph in artificial culture, attained in 1895 results bordering seemingly so closely on success that the Board deemed it requisite to seek through Dr. Klein independent test of the "vaccine material" obtainable by Dr. Copeman's methods. In Appendix B., No. 6, Dr. Klein records the results of his work in this connexion. These, so far as vaccinia as such is concerned, are less definite perhaps than had been anticipated. But, incidentally, and by adopting the later development of Dr. Copeman's processes of lymph culture, Dr. Klein has obtained evidence that a particular microbe, found alike by himself and by Dr. Copeman in variolous lymph, and which is under strong suspicion as the essential cause of small-pox, is, as Dr. Copeman has gone far to demonstrate, cultivateable in artificial media apart from the animal body.

PLAGUE BACILLUS.

As already mentioned at p. xviii. of my report, a subculture of the plague bacillus, obtained from the enlarged glands in the groin of an Asiatic who died in October last at the Branch Seamen's Hospital in the Port of London, was supplied to me by the officers of the British Institute of Preventive Medicine. This subculture, and a similar subculture received direct from Hong Kong, have been submitted by Dr. Klein to test and experiment, and in Appendix B., No. 7, he reports in detail his observations of the microbe which is the essential cause of bubonic plague.

In enumerating the various features, morphological and cultural, of the plague bacillus, with a view to distinguishing it from other and similar micro-organisms, Dr. Klein notes as of special importance, certain peculiarities of the microbe in artificial culture on gelatine. But he does not rely on cultural characters alone for the differentiation of this bacillus. He prefers to test all suspected plague material on the guinea-pig, an animal which he finds exceptionally susceptible to the disease in question. Plague material, of whatever sort, whether derived directly from the infected animal body or indirectly obtained therefrom by means of artificial culture, produces on subcutaneous, and especially on intra-peritoneal, injection into the guinea-pig very definite pathological results, some of which, as Dr. Klein

proceeds to show, differ wholly from those produced by any other septicæmic infection of this animal. Somewhat to his surprise, however, Dr. Klein did not find it practicable to render the guinea-pig immune to plague infection. This animal, repeatedly injected by him with sub-lethal doses of plague-blood, or of living culture of the plague bacillus, reacted always in vigorous fashion, and thereafter was hardly more tolerant than before of an ordinarily fatal dose of plague virus. So, too, with sterilised cultures of the plague bacillus. Guinea-pigs repeatedly injected therewith, instead of obtaining, as when similarly treated with sterile culture of certain other pathogenic bacteria, protection against the living microbe of experiment, never failed to react conspicuously when subjected subsequently to injection of living plague virus. In these circumstances the blood serum of the animals which Dr. Klein had sought to immunise in the one and the other way failed, as was to be anticipated, to exhibit in further experiments any definite curative or prophylactic property.

I have the honour to be,
Sir,
Your obedient servant,
RICHARD T. THORNE.

October 1897.

APPENDICES.

App. A. No. 1.

Digest of Vaccination Officers' Returns, 1894.

APPENDIX A.

No. 1.

Digest of the Vaccination Officers' Returns with regard to Children whose Births were registered in the Year 1894.

The following is a summary of the twenty-third annual return under the Vaccination Act, 1871. Of 889,944 births returned to the Board by the several Vaccination Officers in England and Wales as registered during the year 1894, the number which, at the time the return was made, had been registered as successfully vaccinated was 626,126 (being 70·4 per cent. of the whole), and the number registered as having died unvaccinated was 89,726 (or 10·1 per cent. of the whole). Of the remaining 174,092 children, 3,032 (or 0·3 per cent. of the whole) had been registered as insusceptible of vaccination; 29 (or 0·003 per cent.) as having contracted small-pox before they had been vaccinated; 14,896 (or 1·7 per cent.) as having their vaccination postponed by medical certificate; leaving 156,135 (or 17·5 per cent.) as "removed," "not to be traced," or otherwise unaccounted for. If from the 889,944 births returned by these officers deduction be first made of the deaths that took place before vaccination, it appears that of the surviving 800,218 children, there were registered at the time of the return 78·2 per cent. as successfully vaccinated; 0·4 per cent. as either insusceptible of vaccination, or as having had small-pox; and 1·9 per cent. as under medical certificate of postponement; leaving 19·5 per cent. as at that time still unaccounted for as regards vaccination.

The proportion of cases unaccounted for in the metropolitan returns for 1894 is 20·6 per cent.; in the provincial returns, 19·0. Of the registered births of the twenty-three years 1872–94, the proportion not

App A. No 1.

Digest of Vaccination Officers' Returns, 1894.

finally accounted for in regard to vaccination in each year respectively has been as follows:—

—	Metropolis.	Rest of England.	—	Metropolis.	Rest of England.
1872	8·8	4·5	1884	6·8	5·3
1873	8·7	4·2	1885	7·0	5·5
1874	8·8	4·1	1886	7·8	6·1
1875	9·3	3·8	1887	9·0	6·7
1876	6·5	4·0	1888	10·3	8·2
1877	7·1	4·1	1889	11·6	9·6
1878	7·1	4·3	1890	13·9	10·9
1879	7·8	4·5	1891	16·4	12·9
1880	7·0	4·5	1892	18·4	14·3
1881	5·7	4·3	1893	18·2	15·7
1882	6·6	4·5	1894	20·6	19·0
1883	6·5	4·9			

In 1894 the proportion of cases unaccounted for, after deduction of the postponed cases, in the Metropolis and in the rest of England, was 19·2 and 17·3 per cent. respectively.

App. A. No. 1.

Digest of Vaccination Officers' Returns, 1894.

—	Returns, 1894.							
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of Births.
ENGLAND & WALES -	889,944	626,126	3,032	29	89,726	14,896	156,135	19·2
Ditto (excluding Metropolitan Unions).	758,443	534,837	2,415	26	77,255	13,003	130,907	19·0
Metropolitan Unions -	131,501	91,289	617	3	12,471	1,893	25,228	20·6
COUNTIES.								
England:								
Bedford - - -	4,542	837	4	—	500	10	3,191	70·4
Berks - - -	7,083	5,638	14	—	572	312	547	12·1
Bucks - - -	4,543	2,737	13	—	422	48	1,323	30·2
Cambridge - -	5,186	4,351	22	—	435	107	271	7·3
Chester - - -	21,102	17,516	98	—	2,107	374	1,007	6·5
Cornwall - - -	8,375	5,460	10	—	879	142	1,884	24·2
Cumberland - -	7,890	5,994	12	—	707	182	995	14·9
Derby - - -	14,210	8,212	20	—	1,513	115	4,350	31·4
Devon - - -	16,290	13,352	35	—	1,448	377	1,078	8·9
Dorset - - -	4,958	3,882	6	—	376	85	609	14·0
Durham - - -	37,874	27,700	86	—	4,395	689	5,004	15·0
Essex - - -	25,575	18,773	112	1	1,953	761	3.975	18·5
Gloucester - -	14,857	7,973	56	1	1,480	488	4,859	36·0
Hereford - - -	2,932	2,347	4	—	258	69	254	11·0
Hertford - - -	6,947	4,985	14	1	550	114	1,283	20·1
Huntingdon - -	1,216	1,067	3	—	92	10	44	4·4
Kent (extra-metrop.) -	22,301	17,743	77	11	1,889	446	2,135	11·6
Lancaster - -	128,157	87,007	448	3	14,727	1,845	24,127	20·3
Leicester - - -	11,904	1,269	5	—	1,679	24	8,927	71·0
Lincoln - - -	12,999	9,103	53	—	1,345	284	2,214	19·2
Middlesex (ex.-metrop.)	16,557	12,607	113	—	1,324	285	2,228	15·2
Monmouth - -	9,753	7,197	17	—	939	297	1,303	16·4
Norfolk - - -	12,639	7,660	19	—	1,315	139	3,506	28·8
Northampton - -	9,170	2,591	7	—	995	30	5,547	60·8
Northumberland -	16,805	12,670	56	—	1,841	450	1,788	13·3
Nottingham - -	16,759	11,494	51	—	1,865	403	2,946	20·0
Oxford - - -	4,829	3,465	12	—	400	57	895	19·7

App. A. No. 1.

Digest of Vaccination Officers' Returns, 1894.

—	Returns, 1894. Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of Births.
COUNTIES—*cont.*								
England—*cont.*								
Rutland - - -	510	437	—	—	48	2	23	4·9
Salop - - -	6,871	5,649	16	—	587	91	528	9·0
Somerset - -	14,089	9,726	38	—	1,297	277	2,751	21·5
Southampton - -	18,410	15,010	82	—	1,479	340	1,499	10·0
Stafford - - -	34,485	23,628	95	5	4,035	626	6,096	19·5
Suffolk - - -	9,9[illegible]1	7,871	13	—	818	163	1,036	12·1
Surrey (extra-metrop.) -	14,974	11,154	52	—	1,193	404	2,171	17·2
Sussex - - -	14,224	10,333	31	—	1,138	217	2,505	19·1
Warwick - - -	24,708	17,789	102	2	2,764	268	4,483	19·2
Westmorland - -	1,568	1,381	5	—	129	21	32	3·4
Wilts - - -	6,708	4,184	7	—	519	201	1,797	29·8
Worcester - -	18,408	14,193	79	1	1,786	227	2,122	12·8
York, East Riding -	12,653	9,782	75	—	1,233	169	1,394	12·4
York, North Riding -	10,216	7,962	18	—	1,016	180	1,040	11·9
York, West Riding -	75,869	51,637	352	1	8,088	923	14,868	20·8
Wales:								
Anglesey - - -	805	688	1	—	75	4	37	5·1
Brecknock - -	1,512	1,220	1	—	140	30	121	10·0
Cardigan - - -	1,546	1,292	—	—	152	27	75	6·6
Carmarthen - -	4,127	3,540	3	—	381	58	145	4·9
Carnarvon - -	3,227	2,638	5	—	352	58	174	7·2
Denbigh - - -	2,956	2,548	5	—	299	43	61	3·5
Flint - - -	2,444	1,993	12	—	192	54	193	10·1
Glamorgan - -	26,886	22,451	52	—	2,911	339	1,133	5·5
Merioneth - -	1,580	1,329	1	—	167	50	33	5·3
Montgomery - -	1,620	1,395	1	—	154	26	44	4·3
Pembroke - -	2,234	1,868	2	—	235	55	74	5·8
Radnor - - -	459	209	—	—	61	7	182	41·2

App. A. No. 1.

Digest of Vaccination Officers' Returns, 1894.

METROPOLITAN UNIONS.	Returns, 1894.							
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.
Bethnal Green - -	4,671	1,178	—	—	483	32	2,978	64·4
Camberwell - - -	7,429	5,362	29	—	660	250	1,128	18·5
Chelsea - - -	2,727	2,146	23	—	209	25	324	12·8
Fulham - - -	6,718	5,410	38	—	601	75	594	10·0
George, St., Hanover Sq. -	2,751	2,342	14	1	228	22	144	6·0
George, St., in the East -	1,891	1,430	4	—	200	19	238	13·6
Giles, St., and St. George -	1,091	754	8	—	113	8	208	19·8
Greenwich - - -	5,422	4,536	31	—	468	50	337	7·1
Hackney - - -	6,853	2,440	23	—	481	53	3,856	57·0
Hampstead - - -	1,489	1,230	25	—	118	15	101	7·8
Holborn - - -	4,939	3,635	24	—	479	40	761	16·2
Islington - - -	9,574	7,151	39	1	1,037	101	1,215	13·7
Kensington - - -	3,689	2,948	23	—	342	53	323	10·2
Lambeth - - -	9,287	6,080	48	—	1,008	190	1,961	23·2
Lewisham - - -	2,509	2,031	28	—	215	4	231	9·4
London, City of - -	523	413	2	—	44	14	50	12·2
Marylebone - - -	4,331	3,221	2	—	451	51	606	15·2
Mile End Old Town -	4,077	1,522	5	1	389	—	2,160	53·0
Olave, St. - - -	4,940	3,441	21	—	505	108	865	19·7
Paddington - - -	2,853	2,369	24	—	203	21	236	9·0
Pancras, St. - -	7,014	5,348	33	—	561	227	845	15·3
Poplar - - -	5,849	3,698	59	—	631	58	1,403	25·0
Saviour, St. - -	7,100	5,130	18	—	817	68	1,067	16·0
Shoreditch - - -	4,362	2,306	13	—	505	15	1,463	33·9
Stepney - - -	1,911	1,192	6	—	179	62	472	27·9
Strand - - -	505	374	1	—	63	8	59	13·3
Wandsworth and Clapham	9,511	7,220	51	—	842	275	1,123	14·7
Westminster - -	745	453	2	—	61	14	215	30·7
Whitechapel - -	3,185	2,744	4	—	274	13	150	5·1
Woolwich - - -	3,555	3,125	19	—	274	22	115	3·9
	131,501	91,289	617	3	12,471	1,893	25,228	20·6

App. A. No. 1.

Digest of Vaccination Officers' Returns, 1894.

—	Returns, 1894. Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.
BEDFORD.								
Ampthill - - -	403	308	—	—	31	1	63	15·9
Bedford - - -	1,329	297	2	—	142	6	882	66·9
Biggleswade - - -	746	86	—	—	81	—	579	77·6
Leighton Buzzard - -	475	12	—	—	62	—	401	84·4
Luton - - -	1,364	37	2	—	164	3	1,158	85·1
Woburn - - -	225	97	—	—	20	—	108	48·0
	4,542	837	4	—	500	10	3,191	70·4
BERKS.								
Abingdon - - -	513	472	—	—	29	1	11	2·3
Bradfield - - -	435	379	3	—	29	4	20	5·5
Easthampstead - -	343	283	3	—	21	4	32	10·5
Faringdon - - -	333	259	1	—	22	21	30	15·3
Hungerford and Ramsbury	428	382	—	—	35	6	5	2·6
Maidenhead - - -	554	468	—	—	32	7	47	9·7
Newbury - - -	500	429	1	—	40	17	13	6·0
Reading - - -	1,850	1,190	3	—	206	220	231	24·4
Wallingford - - -	346	312	2	—	25	2	5	2·0
Wantage - - -	446	352	—	—	35	4	55	13·2
Windsor - - -	933	785	1	—	67	19	61	8·6
Wokingham - - -	402	327	—	—	31	7	37	10·9
	7,083	5,638	14	—	572	312	547	12·1
BUCKS.								
Amersham - - -	586	252	2	—	44	—	288	49·1
Aylesbury - - -	625	529	4	—	61	16	15	5·0
Buckingham - -	260	180	1	—	27	5	47	20·0
Eton - - -	755	630	5	—	57	11	52	8·3
Newport Pagnell - -	762	523	—	—	70	13	156	22·2
Winslow - - -	191	52	—	—	19	—	120	62·8
Wycombe - - -	1,364	571	1	—	144	3	645	47·5
	4,543	2,737	13	—	422	48	1,323	30·2
CAMBRIDGE.								
Cambridge - - -	930	722	9	—	78	15	106	13·0
Caxton and Arrington -	210	189	1	—	12	2	6	3·8
Chesterton - - -	846	720	2	—	63	10	51	7·2
Ely - - - -	508	425	4	—	43	10	26	7·1
Linton - - -	304	274	—	—	16	5	9	4·6
Newmarket - - -	909	764	1	—	83	44	17	6·7
North Witchford - -	472	415	1	—	38	7	11	3·8
Whittlesey - - -	185	168	1	—	13	2	1	1·6
Wisbech - - -	822	674	3	—	89	12	44	6·8
	5,186	4,351	22	—	435	107	271	7·3

App. A. No. 1.

Digest of Vaccination Officers' Returns, 1894.

—	Returns, 1894.							
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.
CHESHIRE.								
Birkenhead - - -	4,226	3,769	24	—	354	14	65	1·9
Bucklow - - -	1,738	1,534	6	—	133	34	31	3·7
Chester - - -	1,462	1,246	3	—	156	18	39	3·9
Congleton - - -	957	787	2	—	100	16	52	7·1
Macclesfield - - -	1,630	1,393	5	—	139	42	51	5·7
Nantwich - - -	2,127	1,757	9	—	208	53	100	7·2
Northwich - - -	2,018	1,818	—	—	175	11	14	1·2
Runcorn - - -	1,370	1,030	21	—	133	77	109	13·6
Stockport - - -	4,110	2,928	22	—	604	95	461	13·5
Tarvin - - -	391	365	1	—	18	2	5	1·8
Wirral - - -	1,073	889	5	—	87	12	80	8·6
	21,102	17,516	98	—	2,107	374	1,007	6·5
CORNWALL.								
Austell, St. - - -	897	693	1	—	75	11	117	14·3
Bodmin - - -	489	400	2	—	37	10	40	10·2
Camelford - - -	186	145	—	—	18	11	12	12·4
Columb, St., Major - -	390	318	—	—	28	30	14	11·3
Falmouth - - -	576	86	—	—	63	—	427	74·1
Germans, St. - -	458	383	—	—	52	8	15	5·0
Helston - - -	608	453	—	—	91	16	48	10·5
Launceston - - -	369	321	—	—	41	5	2	1·9
Liskeard - - -	648	518	1	—	64	7	58	10·0
Penzance - - -	1,352	956	—	—	169	10	217	16·8
Redruth - - -	1,409	721	—	—	141	22	525	38·8
Stratton - - -	175	139	—	—	24	3	9	6·9
Truro - - -	818	327	6	—	76	9	400	50·0
	8,375	5,460	10	—	879	142	1,884	24·2
CUMBERLAND.								
Alston-with-Garrigill -	64	51	—	—	6	3	4	10·9
Bootle - - -	474	364	4	—	38	13	55	14·3
Brampton - - -	241	193	1	—	20	11	16	11·2
Carlisle - - -	1,676	1,411	4	—	158	79	24	6·1
Cockermouth - -	2,168	1,116	1	—	235	30	786	37·6
Longtown - - -	167	146	—	—	14	1	6	4·2
Penrith - - -	582	503	2	—	51	16	10	4·5
Whitehaven - - -	1,811	1,581	—	—	127	21	82	5·7
Wigton - - -	707	629	—	—	58	8	12	2·8
	7,890	5,994	12	—	707	182	995	14·9
DERBY.								
Ashbourne - - -	556	480	—	—	44	1	31	5·8
Bakewell - - -	848	686	—	—	83	14	65	9·3
Belper - - -	2,133	1,635	4	—	223	8	263	12·7
Chapel-en-le-Frith - -	666	541	3	—	60	16	46	9·3
Chesterfield - - -	4,335	2,748	6	—	476	47	1,058	25·5
Derby - - -	2,934	453	2	—	345	—	2,134	72·7
Glossop - - -	715	422	2	—	92	6	193	27·8
Hayfield - - -	337	266	1	—	41	—	29	8·6
Shardlow - - -	1,686	981	2	—	149	23	531	32·9
	14,210	8,212	20	—	1,513	115	4,350	31·4

App. A. No. 1.

Digest of Vaccination Officers' Returns, 1894.

—	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.
	Returns, 1894.							
DEVON.								
Axminster	423	366	1	—	29	9	18	6·4
Barnstaple	1,003	811	6	—	91	48	47	9·5
Bideford	604	522	—	—	50	23	9	5·3
Crediton	451	407	—	—	30	2	12	3·1
East Stonehouse	479	269	1	—	57	3	149	31·7
Exeter	903	646	1	—	103	37	116	16·9
Holsworthy	235	206	—	—	17	6	6	5·1
Honiton	501	445	2	—	35	5	14	3·8
Kingsbridge	406	358	—	—	37	4	7	2·7
Newton Abbot	1,764	1,586	6	—	121	21	30	2·9
Okehampton	397	346	—	—	27	7	17	6·0
Plymouth	2,546	1,841	3	—	295	53	354	16·0
Plympton St. Mary	642	543	—	—	55	5	39	6·9
Southmolton	371	324	—	—	28	13	6	5·1
Stoke Damerel	1,476	1,130	2	—	133	59	152	14·3
Tavistock	666	600	1	—	50	4	11	2·3
Thomas, St.	1,318	1,088	2	—	122	61	45	8·0
Tiverton	714	589	4	—	83	6	32	5·3
Torrington	343	317	—	—	14	5	7	3·5
Totnes	1,048	958	6	—	71	6	7	1·2
	16,290	13,352	35	—	1,448	377	1,078	8·9
DORSET.								
Beaminster	280	249	—	—	16	2	13	5·4
Blandford	298	240	—	—	18	3	37	13·4
Bridport	323	281	2	—	31	7	2	2·8
Cerne	146	132	—	—	10	2	2	2·7
Dorchester	447	389	1	—	28	7	22	6·5
Poole	902	650	—	—	88	10	154	18·2
Shaftesbury	280	223	—	—	25	4	28	11·4
Sherborne	305	258	—	—	21	4	22	8·5
Sturminster	233	208	—	—	17	2	6	3·4
Wareham and Purbeck	395	349	2	—	33	4	7	2·8
Weymouth	865	513	—	—	59	24	269	33·9
Wimborne and Cranborne	484	390	1	—	30	16	47	13·0
	4,958	3,882	6	—	376	85	609	14·0
DURHAM.								
Auckland	3,174	2,300	4	—	384	78	408	15·3
Chester-le-Street	2,096	1,643	3	—	296	47	107	6·4
Darlington	1,529	621	2	—	186	23	697	47·1
Durham	2,521	2,118	14	—	256	23	110	5·3
Easington	1,982	1,684	—	—	229	16	53	3·5
Gateshead	5,086	2,796	6	—	663	91	1,530	31·9
Hartlepool	2,545	2,078	13	—	250	37	167	8·0
Houghton-le-Spring	1,594	1,355	9	—	181	16	33	3·1
Lanchester	2,452	1,863	4	—	273	37	275	12·7
Sedgefield	718	625	—	—	78	1	14	2·1
South Shields	5,204	3,727	10	—	575	148	744	17·1
Stockton	2,019	1,675	3	—	203	35	103	6·8
Sunderland	5,927	4,453	17	—	722	127	608	12·4
Teesdale	606	393	1	—	62	7	143	24·8
Weardale	421	369	—	—	37	3	12	3·6
	37,874	27,700	86	—	4,395	689	5,004	15·0

—	Returns, 1894.							
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.
ESSEX.								
Billericay	473	396	8	—	29	18	22	8·5
Braintree	678	586	1	—	47	25	19	6·5
Chelmsford	789	702	2	—	47	13	25	4·8
Colchester	995	751	4	—	68	13	159	17·3
Dunmow	382	332	—	—	32	3	15	4·7
Epping	691	569	1	—	59	11	51	9·0
Halstead	417	375	—	—	24	8	10	4·3
Lexden and Winstree	595	523	3	—	47	11	11	3·7
Maldon	675	609	1	—	43	2	20	3·3
Ongar	272	230	—	—	19	4	19	8·5
Orsett	916	549	4	—	80	38	245	30·9
Rochford	980	687	6	—	76	7	204	21·5
Romford	1,933	1,351	1	—	2	187	392	20·3
Saffron Walden	458	411	—	—	23	2	22	5·2
Tendring	1,124	929	4	—	96	16	79	8·5
West Ham	14,197	9,773	77	1	1,261	403	2,682	21·7
	25,575	18,773	112	1	1,953	761	3,975	18·5
GLOUCESTER.								
Barton Regis	5,723	4,147	33	—	564	407	572	17·1
Bristol	1,438	1,028	7	—	168	4	231	16·3
Cheltenham	1,210	361	2	—	146	—	701	57·9
Chipping Sodbury	422	298	—	—	24	17	83	23·7
Cirencester	500	402	2	—	54	3	39	8·4
Dursley	302	128	1	—	19	5	149	51·0
Gloucester	1,492	34	—	—	187	—	1,271	85·2
Newent	263	177	—	1	20	1	64	24·7
Northleach	204	181	—	—	10	1	12	6·4
Stow-on-the-Wold	221	166	6	—	14	1	34	15·8
Stroud	1,005	297	4	—	77	12	615	62·4
Tetbury	178	85	1	—	13	—	79	44·4
Tewkesbury	355	62	—	—	35	2	256	72·7
Thornbury	437	371	—	—	34	11	21	7·3
Westbury-on-Severn	728	61	—	—	75	—	592	81·3
Wheatenhurst	152	16	—	—	12	4	120	81·6
Winchcomb	227	159	—	—	28	20	20	17·6
	14,857	7,973	56	1	1,480	488	4,859	36·0
HEREFORD.								
Bromyard	306	257	—	—	18	13	18	10·1
Dore	186	147	1	—	22	4	12	8·6
Hereford	889	695	1	—	94	15	84	11·1
Kington	251	199	—	—	21	4	27	12·4
Ledbury	320	277	1	—	23	5	14	5·9
Leominster	331	266	1	—	35	4	25	8·8
Ross	460	354	—	—	29	18	59	16·7
Weobley	189	152	—	—	16	6	15	11·1
	2,932	2,347	4	—	258	69	254	11·0

App. A. No. 1.

Digest of Vaccination Officers' Returns, 1894.

—	Returns, 1894.							
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.
HERTS.								
Albans, St.	747	214	—	—	51	15	467	64·5
Barnet	1,270	984	1	1	100	46	138	14·5
Berkhampstead	406	326	—	—	37	14	29	10·6
Bishop's Stortford	523	457	—	—	34	9	23	6·1
Buntingford	122	104	—	—	9	1	8	7·4
Hatfield	192	156	1	—	22	1	12	6·8
Hemel Hempstead	378	237	—	—	34	7	100	28·3
Hertford	434	359	—	—	22	1	52	12·2
Hitchin	718	617	1	—	70	—	30	4·2
Royston	417	364	1	—	31	3	18	5·0
Ware	542	489	1	—	34	1	17	3·3
Watford	1,138	624	9	—	104	16	385	35·2
Welwyn	60	54	—	—	2	—	4	6·6
	6,947	4,985	14	1	550	114	1,283	20·1
HUNTINGDON.								
Huntingdon	493	437	—	—	37	7	12	3·9
Ives, St.	384	336	2	—	31	2	13	3·9
Neots, St.	339	294	1	—	24	1	19	5·9
	1,216	1,067	3	—	92	10	44	4·4
KENT (Extra-Metropolitan).								
Ashford, East	349	306	2	—	29	3	9	3·4
Ashford, West	531	430	4	—	42	26	29	10·4
Blean	538	459	1	—	41	2	35	6·9
Bridge	300	247	3	—	25	8	17	8·3
Bromley	1,818	1,293	11	—	186	93	235	18·0
Canterbury	476	412	—	—	31	3	30	6·9
Cranbrook	333	276	1	—	23	2	31	9·9
Dartford	2,143	1,774	15	—	182	18	154	8·0
Dover	1,135	814	1	—	88	29	203	20·4
Eastry	727	660	—	—	48	2	17	2·6
Elham	1,116	945	1	—	81	44	45	8·0
Faversham	789	710	3	—	59	3	14	2·2
Gravesend and Milton	644	475	3	—	58	2	106	16·8
Hollingbourn	346	287	1	—	37	2	19	6·1
Hoo	116	104	1	—	10	—	1	0·9
Maidstone	1,331	902	5	10	111	28	275	22·8
Malling	821	715	—	—	64	10	32	5·1
Medway	2,239	1,921	—	—	202	32	84	5·2
Milton	845	669	5	—	79	31	61	10·9
Romney Marsh	172	153	1	—	12	2	4	3·5
Sevenoaks	753	628	2	—	52	29	42	9·4
Sheppey	490	416	5	—	36	18	15	6·7
Strood	1,170	995	11	1	109	4	50	4·6
Tenterden	251	212	—	—	28	—	11	4·4
Thanet, Isle of	1,373	1,229	1	—	100	13	30	3·1
Tonbridge	1,495	711	—	—	156	42	586	42·0
	22,301	17,743	77	11	1,889	446	2,135	11·6

—	Returns, 1894.							
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.
LANCASTER.								
Ashton-under-Lyne -	4,752	1,472	6	—	700	31	2,543	54·2
Barrow-in-Furness -	1,539	1,334	3	—	136	21	45	4·3
Barton-upon-Irwell -	2,677	1,638	15	—	332	98	594	25·8
Blackburn - - -	6,173	4,857	36	1	701	79	499	9·4
Bolton - - -	7,489	6,244	26	—	785	14	420	5·8
Burnley - - -	5,709	1,973	33	—	729	126	2,848	52·1
Bury - - - -	3,699	811	7	—	510	7	2,364	64·1
Chorley - - -	1,894	1,531	8	—	186	44	125	8·9
Chorlton - - -	9,328	7,058	10	—	1,058	200	1,002	12·9
Clitheroe - - -	595	463	4	—	57	11	60	11·9
Fylde, The - - -	1,783	1,401	25	—	176	21	160	10·2
Garstang - - -	266	227	—	—	20	5	14	7·1
Haslingden - - -	2,679	1,799	7	—	263	37	573	22·8
Lancaster - - -	1,625	1,401	4	—	132	25	63	5·4
Leigh - - - -	2,725	2,198	3	—	244	33	247	10·3
Liverpool - - -	5,074	4,208	14	—	643	11	198	4·1
Lunesdale - - -	184	165	—	—	14	1	4	2·7
Manchester - - -	4,817	4,177	4	—	518	45	73	2·4
Oldham - - -	5,766	205	1	—	945	1	4,614	80·0
Ormskirk - - -	2,721	2,256	24	—	256	53	132	6·8
Prescot - - -	5,255	4,281	18	—	595	57	304	6·9
Preston - - -	4,547	2,890	9	1	743	52	852	19·9
Prestwich - - -	4,966	3,658	15	—	429	92	712	16·4
Rochdale - - -	2,901	740	2	—	387	4	1,768	61·1
Salford - - -	7,322	5,034	28	—	948	288	1,024	17·9
Todmorden - - -	814	128	1	—	84	1	600	73·8
Toxteth Park - -	4,033	3,189	21	1	453	69	300	9·1
Ulverston - - -	1,113	955	3	—	97	28	30	5·2
Warrington - - -	3,422	2,913	32	—	284	34	159	5·6
West Derby - - -	15,560	12,854	66	—	1,516	194	930	7·2
Wigan - - -	6,789	4,947	23	—	786	163	870	15·2
	128,157	87,007	448	3	14,727	1,845	24,127	20·3
LEICESTER.								
Ashby-de-la-Zouch - -	1,326	359	2	—	182	11	772	59·0
Barrow-on-Soar - -	707	26	—	—	79	—	602	85·1
Billesdon - - -	141	106	—	—	8	3	24	19·1
Blaby - - -	698	20	1	—	75	1	601	86·2
Hinckley - - -	730	93	—	—	99	2	536	73·7
Leicester - - -	5,995	93	1	—	953	—	4,948	82·5
Loughborough - -	946	60	—	—	142	2	742	78·4
Lutterworth - -	262	177	1	—	17	1	66	25·6
Market Bosworth - -	515	238	—	—	50	4	223	44·1
Market Harborough* -								
Melton Mowbray - -	584	97	—	—	74	—	413	70·7
	11,904	1,269	5	—	1,679	24	8,927	71·0
LINCOLN.								
Boston - - -	1,024	712	4	—	113	68	127	19·0
Bourne - - -	500	368	—	—	46	4	82	17·2
Caistor - - -	413	332	2	—	43	16	20	8·7
Gainsborough - -	1,037	325	1	—	134	2	575	55·6
Glanford Brigg - -	1,264	1,005	6	—	115	—	138	10·9
Grantham - - -	920	766	16	—	86	5	47	5·7
Grimsby - - -	2,209	1,591	6	—	275	83	254	15·3

* No return relating to children born in the Market Harborough Union during the year 1894 has been received. The number of births registered was 364.

App. A. No. 1.

Digest of Vaccination Officers' Returns, 1894.

—	Returns, 1894.							
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.
LINCOLN—*cont.*								
Holbeach	449	186	—	—	39	1	223	49·9
Horncastle	469	336	2	—	37	7	87	20·0
Lincoln	1,877	1,476	5	—	214	64	118	9·7
Louth	694	525	3	—	65	17	84	14·6
Sleaford	605	432	2	—	58	6	107	18·7
Spalding	556	197	1	—	57	4	297	54·1
Spilsby	591	517	1	—	40	7	26	5·6
Stamford	391	335	4	—	23	—	29	7·4
	12,999	9,103	53	—	1,345	284	2,214	19·2
MIDDLESEX (Extra-Metropolitan).								
Brentford	3,970	3,262	31	—	358	14	305	8·0
Edmonton	7,685	5,649	43	—	605	207	1,181	18·1
Hendon	3,304	2,367	34	—	238	53	612	20·1
Staines	759	599	1	—	64	1	94	12·5
Uxbridge	839	730	4	—	59	10	36	5·5
	16,557	12,607	113	—	1,324	285	2,228	15·2
MONMOUTH.								
Abergavenny	715	589	2	—	69	31	24	7·7
Bedwellty	2,611	1,775	1	—	259	152	424	22·1
Chepstow	548	387	—	—	40	2	119	22·1
Monmouth	868	555	1	—	69	19	224	28·0
Newport	3,531	2,856	7	—	372	71	225	8·4
Pontypool	1,480	1,035	6	—	130	22	287	20·9
	9,753	7,197	17	—	939	297	1,303	16·4
NORFOLK.								
Aylsham	469	409	—	—	36	9	15	5·1
Blofield	265	208	—	—	25	5	27	12·1
Depwade	579	457	—	—	58	15	49	11·1
Docking	435	369	—	—	42	1	23	5·5
Downham	468	385	1	—	55	7	20	5·8
Erpingham	543	434	3	—	49	15	42	10·5
Faith, St.	323	187	—	—	37	2	97	30·7
Flegg, East and West	291	244	—	—	28	8	11	6·5
Forehoe	301	236	—	—	19	1	45	15·3
Freebridge Lynn	336	291	—	—	21	3	21	7·1
Guiltcross	272	233	—	—	23	2	14	5·9
Henstead	260	193	1	—	18	1	47	18·5
King's Lynn	527	39	—	—	93	—	395	75·0
Loddon and Clavering	338	273	—	—	34	3	28	9·2
Mitford and Launditch	645	545	4	—	48	8	40	7·4
Norwich	3,147	458	2	—	491	—	2,296	73·0
Smallburgh	456	354	3	—	48	4	47	11·2
Swaffham	303	224	—	—	31	8	40	15·8
Thetford	451	407	1	—	32	4	7	2·4
Walsingham	523	422	2	—	66	5	28	6·3
Wayland	270	234	—	—	22	4	10	5·2
Yarmouth, Great	1,437	1,058	2	—	139	34	204	16·6
	12,639	7,660	19	—	1,315	139	3,506	28·8

—	Returns, 1894.							
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.
NORTHAMPTON.								
Brackley	269	34	1	—	28	—	206	76·6
Brixworth	318	174	—	—	21	—	123	38·7
Daventry	436	298	1	—	50	5	82	20·0
Hardingstone	318	172	2	—	34	1	109	34·6
Kettering	1,293	28	—	—	177	—	1,088	84·1
Northampton	2,477	100	2	—	311	4	2,060	83·3
Oundle	298	257	—	—	18	4	19	7·7
Peterborough	1,280	1,102	—	—	99	4	75	6·2
Potterspury	330	212	—	—	31	5	82	26·4
Thrapston	394	47	—	—	35	—	312	79·2
Towcester	281	154	1	—	27	7	92	35·2
Wellingborough	1,476	13	—	—	164	—	1,299	88·0
	9,170	2,591	7	—	995	30	5,547	60·8
NORTHUMBERLAND.								
Alnwick	676	572	1	—	43	14	46	8·9
Belford	127	108	—	—	14	2	3	3·9
Bellingham	126	111	—	—	5	—	10	7·9
Berwick-upon-Tweed	571	495	1	—	62	10	3	2·3
Castle Ward	690	556	3	—	56	1	74	10·9
Glendale	219	188	2	—	13	—	16	7·3
Haltwhistle	243	123	—	—	15	8	97	43·2
Hexham	923	747	—	—	84	6	86	10·0
Morpeth	1,679	890	—	—	292	16	481	29·6
Newcastle-on-Tyne	6,688	5,368	14	—	672	35	599	9·5
Rothbury	134	124	—	—	8	—	2	1·5
Tynemouth	4,729	3,388	35	—	577	358	371	15·4
	16,805	12,670	56	—	1,841	450	1,788	13·3
NOTTINGHAM.								
Basford	5,792	4,078	17	—	660	184	853	17·9
Bingham	352	279	1	—	28	17	27	12·5
East Retford	670	566	3	—	68	6	27	4·9
Mansfield	2,408	1,491	11	—	278	25	603	26·1
Newark	764	654	—	—	57	8	45	6·9
Nottingham	5,166	3,041	15	—	661	125	1,324	28·0
Southwell	469	388	2	—	33	19	27	9·8
Worksop	1,138	997	2	—	80	19	40	5·2
	16,759	11,494	51	—	1,865	403	2,946	20·0
OXFORD.								
Banbury	744	88	—	—	62	1	593	79·8
Bicester	340	271	—	—	27	6	36	12·4
Chipping Norton	466	304	1	—	51	14	96	23·6
Headington	881	783	4	—	67	8	19	3·1
Henley	619	510	—	—	42	4	63	10·8
Oxford	564	474	3	—	64	5	18	4·1
Thame	338	287	—	—	23	5	23	4·3
Witney	541	479	3	—	35	8	16	4·4
Woodstock	336	269	1	—	29	6	31	11·0
	4,829	3,465	12	—	400	57	895	19·7

App. A. No. 1.

Digest of Vaccination Officers' Returns, 1894.

—	Returns, 1894.							
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.
RUTLAND.								
Oakham	272	237	—	—	26	2	7	3·3
Uppingham	238	200	—	—	22	—	16	6·7
	510	437	—	—	48	2	23	4·9
SALOP.								
Atcham	1,307	1,067	2	—	126	29	83	8·6
Bridgnorth	349	291	—	—	31	3	24	7·7
Church Stretton	140	123	—	—	13	—	4	2·9
Cleobury Mortimer	239	208	—	—	16	8	7	6·1
Clun	225	119	1	—	19	—	86	38·2
Drayton	377	340	5	—	28	1	3	1·1
Ellesmere	338	298	2	—	30	4	4	2·4
Ludlow	451	387	—	—	40	7	17	5·3
Madeley	659	571	—	—	52	8	28	5·5
Newport	407	354	—	—	36	4	13	4·2
Oswestry	743	657	2	—	56	12	16	3·8
Shifnal	332	264	—	—	24	5	39	13·3
Wellington	724	450	1	—	77	1	195	27·1
Wem	271	252	3	—	13	1	2	1·1
Whitchurch	309	268	—	—	26	8	7	4·9
	6,871	5,649	16	—	587	91	528	9·0
SOMERSET.								
Axbridge	978	346	3	—	92	9	528	54·9
Bath	1,871	1,321	6	—	198	92	254	18·5
Bedminster	2,633	1,499	7	—	278	10	839	32·2
Bridgwater	948	644	1	—	81	25	197	23·4
Chard	643	539	—	—	63	9	32	6·4
Clutton	760	597	—	—	80	10	73	10·9
Dulverton	132	125	—	—	4	1	2	2·3
Frome	537	452	—	—	37	4	44	8·9
Keynsham	1,079	562	4	—	102	26	385	38·1
Langport	357	286	—	—	23	3	45	13·4
Shepton Mallet	461	341	2	—	37	11	70	17·6
Taunton	997	867	3	—	72	14	41	5·5
Wellington	493	350	—	—	34	10	99	22·1
Wells	587	466	2	—	59	17	43	10·2
Williton	443	393	3	—	23	8	16	5·4
Wincanton	445	345	6	—	44	4	46	11·2
Yeovil	725	593	1	—	70	24	37	8·4
	14,089	9,726	38	—	1,297	277	2,751	21·5
SOUTHAMPTON.								
Alresford	150	147	—	—	2	—	1	0·7
Alton	431	371	2	—	35	3	20	5·3
Alverstoke	774	701	1	—	63	4	5	1·2
Andover	387	320	1	—	23	6	37	11·1
Basingstoke	496	245	—	—	18	—	233	47·0
Catherington	80	68	—	—	9	—	3	3·7
Christchurch	1,438	822	8	—	127	32	449	33·4
Droxford	283	254	—	—	21	2	6	2·8
Fareham	471	433	—	—	23	2	13	3·2
Fordingbridge	174	154	—	—	10	1	9	5·7

—	RETURNS, 1894.							
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.
SOUTHAMPTON—*cont.*								
Hartley Wintney - -	688	553	2	—	37	19	77	14·0
Havant - - -	241	204	1	—	13	14	9	9·5
Hursley - - -	80	73	—	—	6	1	—	1·2
Kingsclere - - -	210	189	—	—	13	3	5	3·8
Lymington - - -	323	259	—	—	29	3	32	10·8
New Forest - - -	361	303	2	—	27	15	14	8·0
Petersfield - - -	286	234	1	—	20	6	25	10·8
Portsea Island - -	4,729	4,147	20	—	412	46	104	3·2
Ringwood - - -	151	128	—	—	16	1	6	4·6
Romsey - - -	263	231	—	—	19	7	6	4·9
Southampton - -	1,796	1,466	30	—	177	28	95	6·8
South Stoneham - -	1,706	1,333	6	—	138	41	188	13·4
Stockbridge - - -	170	149	—	—	12	2	7	5·3
Whitchurch - - -	186	162	—	—	15	1	8	4·8
Wight, Isle of - -	1,727	1,378	4	—	136	85	124	12·1
Winchester, New - -	809	686	4	—	78	18	23	5·1
	18,410	15,010	82	—	1,479	340	1,499	10·0
STAFFORD.								
Burton-on-Trent - -	2,814	1,478	—	—	315	58	963	36·3
Cannock - - -	1,535	1,177	4	—	178	8	168	11·3
Cheadle - - -	833	640	1	—	81	7	104	13·3
Leek - - - -	1,321	1,067	1	—	149	53	51	7·9
Lichfield - - -	1,279	1,116	6	—	116	13	28	3·2
Newcastle-under-Lyme -	1,381	1,248	1	—	109	3	20	1·7
Seisdon - - -	449	364	—	—	33	5	47	11·6
Stafford - - -	886	752	1	—	76	19	38	6·4
Stoke-on-Trent - -	4,760	3,604	5	—	676	62	413	10·0
Stone - - - -	956	792	1	—	98	19	46	6·8
Tamworth - - -	674	467	—	—	68	17	122	20·6
Uttoxeter - - -	407	343	—	—	30	2	32	8·4
Walsall - - -	3,777	1,990	20	—	523	47	1,197	32·9
West Bromwich - -	5,008	2,907	25	—	487	159	1,430	31·7
Wolstanton and Burslem -	3,318	2,668	3	—	432	29	186	6·5
Wolverhampton - -	5,087	3,015	27	5	664	125	1,251	27·0
	34,485	23,628	95	5	4,035	626	6,096	19·5
SUFFOLK.								
Blything - - -	717	633	1	—	56	4	23	3·8
Bosmere and Claydon -	392	335	—	—	24	7	26	8·4
Bury St. Edmunds - -	420	346	—	—	43	15	16	7·4
Cosford - - -	466	416	1	—	35	4	10	3·0
Hartismere - - -	381	322	—	—	28	3	28	8·1
Hoxne - - -	310	270	—	—	29	5	6	3·5
Ipswich - - -	1,705	809	3	—	172	56	665	42·3
Mildenhall - - -	228	207	—	—	13	3	5	3·5
Mutford and Lothingland -	1,198	1,020	2	—	87	12	77	7·4
Plomesgate - - -	555	476	—	—	36	6	37	7·7
Risbridge - - -	473	404	—	—	50	5	14	4·0
Samford - - -	350	300	1	—	36	5	8	3·7
Stow - - - -	522	466	—	—	39	5	12	3·3
Sudbury - - -	739	622	—	—	66	11	40	6·9
Thingoe - - -	435	389	—	—	34	2	10	2·8
Wangford - - -	375	336	1	—	30	3	5	2·1
Woodbridge - - -	635	520	4	—	40	17	54	11·2
	9,901	7,871	13	—	818	163	1,036	12·1

App. A. No. 1.

Digest of Vaccination Officers' Returns, 1894.

—	Returns, 1894.							
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.
SURREY (Extra-Metropolitan).								
Chertsey	839	529	3	—	74	4	229	27·8
Croydon	3,977	2,533	13	—	356	131	944	27·0
Dorking	386	330	1	—	22	3	30	8·5
Epsom	1,147	846	1	—	108	27	165	16·7
Farnham	1,473	1,191	5	—	137	7	133	9·5
Godstone	490	401	1	—	31	9	48	11·6
Guildford	1,294	929	9	—	107	28	221	19·3
Hambledon	505	473	1	—	18	5	8	2·6
Kingston	2,974	2,339	12	—	213	151	259	13·8
Reigate	872	683	2	—	51	35	101	15·6
Richmond	1,017	900	4	—	76	4	33	3·6
	14,974	11,154	52	—	1,193	404	2,171	17·2
SUSSEX.								
Battle	499	360	—	—	33	7	99	21·2
Brighton	2,726	2,206	10	—	284	80	146	8·3
Chailey	251	156	—	—	27	5	63	27·1
Chichester	176	160	—	—	10	1	5	3·4
Cuckfield	593	483	1	—	49	15	45	10·1
Eastbourne	1,137	230	—	—	100	3	804	71·0
East Grinstead	516	298	—	—	29	12	177	36·6
East Preston	782	658	—	—	55	18	51	8·8
Hailsham	394	305	—	—	17	11	61	18·3
Hastings	1,428	1,046	8	—	124	1	249	17·5
Horsham	643	466	2	—	45	6	124	20·2
Lewes	280	117	1	—	30	—	132	47·1
Midhurst	354	312	—	—	27	8	7	4·2
Newhaven	276	236	1	—	17	3	19	8·0
Petworth	228	211	1	—	11	—	5	2·2
Rye	339	283	1	—	26	4	25	8·6
Steyning	1,564	1,359	5	—	117	17	66	5·3
Thakeham	187	168	—	—	12	1	6	3·7
Ticehurst	439	335	—	—	32	1	71	16·4
Uckfield	606	263	—	—	43	3	297	49·5
Westbourne	199	179	—	—	12	—	8	4·0
West Firle	59	38	—	—	5	4	12	27·1
Westhampnett	548	464	1	—	33	17	33	9·1
	14,224	10,333	31	—	1,138	217	2,505	19·1
WARWICK.								
Alcester	521	432	1	—	41	11	36	9·0
Aston	8,962	6,718	55	—	1,002	150	1,037	13·2
Atherstone	533	300	—	—	60	—	173	32·5
Birmingham	7,843	6,236	37	2	943	36	589	8·0
Coventry	1,589	121	—	—	211	—	1,257	79·1
Foleshill	668	270	—	—	76	—	322	48·2
Meriden	233	177	—	—	22	1	33	14·6
Nuneaton	710	68	—	—	82	—	560	78·9
Rugby	753	432	1	—	86	19	215	31·1
Solihull	838	666	7	—	66	15	84	11·8
Southam	293	234	—	—	26	8	25	11·3
Stratford-upon-Avon	518	417	—	—	46	2	53	10·6
Warwick	1,247	1,018	1	—	103	26	99	10·0
	24,708	17,089	102	2	2,764	268	4,483	19·2

—	Returns, 1894.							
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.
WESTMORLAND.								
East Ward - - -	319	268	2	—	33	3	13	5·0
Kendal - - -	1,062	955	3	—	77	18	9	2·5
West Ward - - -	187	158	—	—	19	—	10	5·3
	1,568	1,381	5	—	129	21	32	3·4
WILTS.								
Amesbury - - -	168	146	—	—	15	2	5	4·2
Bradford - - -	254	165	—	—	29	3	57	23·6
Calne - - -	210	111	—	—	15	2	82	40·0
Chippenham - -	551	348	1	—	46	23	133	28·3
Cricklade and Wootton Bassett.	322	179	--	—	22	10	111	37·6
Devizes - - -	480	349	—	—	31	5	95	20·8
Highworth and Swindon -	1,580	552	1	—	128	95	804	56·9
Malmesbury - - -	315	195	3	—	15	14	88	32·4
Marlborough - -	209	185	1	—	17	2	4	2·9
Melksham - - -	437	155	—	—	37	—	245	56·1
Mere - - - -	177	155	—	—	10	7	5	6·8
Pewsey - - -	283	247	—	—	23	3	10	4·6
Salisbury - - -	696	613	1	—	47	4	31	5·0
Tisbury - - -	239	196	—	—	17	13	13	10·9
Warminster - - -	308	193	—	—	32	6	77	26·9
Westbury and Whorwellsdown.	236	188	—	—	25	—	23	9·7
Wilton - - -	243	207	—	—	10	12	14	10·7
	6,708	4,184	7	—	519	201	1,797	29·8
WORCESTER.								
Bromsgrove - - -	912	725	3	—	46	9	129	15·1
Droitwich - - -	516	437	1	—	53	9	16	4·8
Dudley - - -	5,390	4,341	17	—	596	70	366	8·1
Evesham - - -	476	339	—	—	36	4	97	21·2
Kidderminster - -	1,083	937	15	—	80	9	42	4·7
King's Norton - -	3,871	2,430	25	—	359	—	1,057	27·3
Martley - - -	440	372	3	—	30	31	4	8·0
Pershore - - -	352	316	—	—	27	3	6	2·6
Shipston-on-Stour - -	399	334	2	—	26	8	29	9·3
Stourbridge - - -	2,973	2,594	6	1	298	20	54	2·5
Tenbury - - -	182	155	—	—	13	8	6	7·7
Upton-on-Severn - -	494	404	—	—	48	1	41	8·5
Worcester - - -	1,320	809	7	—	174	55	275	25·0
	18,408	14,193	79	1	1,786	227	2,122	12·8
YORK, East Riding.								
Beverley - - -	717	586	3	—	68	19	41	8·4
Bridlington - - -	484	359	—	—	46	3	76	16·8
Driffield - - -	528	469	1	—	47	4	7	2·1
Howden - - -	361	303	2	—	36	4	16	5·5
Kingston-upon-Hull -	2,397	1,817	14	—	248	43	275	13·3
Patrington - - -	199	173	—	—	9	—	17	8·5
Pocklington - - -	384	342	1	—	38	1	2	0·8
Sculcoates - - -	4,853	3,498	34	—	469	42	810	17·6
Skirlaugh - - -	234	204	—	—	18	6	6	5·1
York - - - -	2,496	2,031	20	—	254	47	144	7·7
	12,653	9,782	75	—	1,233	169	1,394	12·4

App. A. No. 1

Digest of Vaccination Officers' Returns, 1894.

—	Returns, 1894.							
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.
YORK, North Riding.								
Aysgarth	124	107	2	—	11	3	1	3·2
Bedale	214	199	—	—	10	1	4	2·3
Easingwold	217	181	—	—	20	—	16	7·4
Guisborough	1,077	929	—	—	88	7	53	5·6
Helmsley	135	108	1	—	12	9	5	10·4
Kirkby Moorside	144	116	—	—	13	9	6	10·4
Leyburn	164	148	—	—	11	2	3	3·0
Malton	607	521	3	—	51	9	23	5·3
Middlesbrough	4,165	3,391	6	—	468	87	213	7·2
Northallerton	282	245	—	—	25	6	6	4·3
Pickering	333	263	1	—	44	14	11	7·5
Reeth	71	65	—	—	6	—	—	0·0
Richmond	327	267	1	—	28	3	28	9·5
Scarborough	1,177	395	4	—	134	—	644	54·7
Stokesley	311	272	—	—	30	3	6	2·9
Thirsk	314	271	—	—	31	2	10	3·8
Whitby	554	484	—	—	34	25	11	6·5
	10,216	7,962	18	—	1,016	180	1,040	11·9
YORK, West Riding.								
Barnsley	4,064	3,385	24	—	408	16	231	6·1
Bierley, North	3,709	2,279	13	—	386	73	958	27·8
Bradford	5,619	3,310	40	—	708	45	1,516	27·8
Bramley	2,317	1,530	6	—	289	10	482	21·2
Dewsbury	4,580	1,687	13	—	699	102	2,079	47·6
Doncaster	2,244	1,681	18	—	234	110	201	13·9
Ecclesall Bierlow	4,555	3,911	32	—	400	27	185	4·7
Goole	883	684	2	—	91	7	99	12·0
Halifax	4,503	203	2	—	417	—	3,881	86·2
Hemsworth	620	512	1	—	64	3	40	6·9
Holbeck	949	745	8	—	154	12	30	4·4
Huddersfield	3,688	3,241	31	—	336	12	68	2·2
Hunslet	2,613	2,183	12	—	287	47	84	5·0
Keighley	1783	38	—	—	216	—	1,529	85·8
Knaresborough	754	532	1	—	59	7	155	21·5
Leeds	7,316	6,052	24	—	715	106	419	7·2
Ouseburn, Great	355	310	1	—	33	1	10	3·1
Pateley Bridge	238	214	2	—	15	2	5	2·9
Penistone	522	429	—	—	27	8	58	12·6
Pontefract	2,306	1,877	14	—	213	105	97	8·8
Ripon	399	299	—	—	44	1	55	14·0
Rotherham	3,505	2,922	11	—	355	56	161	6·2
Saddleworth	598	69	1	—	84	—	444	72·2
Sedbergh	109	96	—	—	10	2	1	2·8
Selby	457	392	—	—	39	10	16	5·7
Settle	354	276	1	—	38	7	32	11·0
Sheffield	7,557	5,911	56	—	869	39	682	9·5
Skipton	1,086	320	1	—	113	8	644	60·0
Tadcaster	918	786	7	—	88	3	34	4·0
Thorne	443	315	—	—	43	17	68	19·2
Wakefield	3,585	2,949	14	1	360	43	218	7·3
Wetherby	375	288	2	—	38	15	32	12·5
Wharfedale	1,402	1,026	6	—	134	16	220	16·8
Wortley	1,463	1,185	9	—	122	13	134	10·0
	75,869	51,637	352	1	8,088	923	14,868	20·8

—	Returns, 1894.							
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.
ANGLESEY.								
Anglesey	325	268	—	—	37	—	20	6·2
Holyhead	480	420	1	—	38	4	17	4·4
	805	688	1	—	75	4	37	5·1
BRECKNOCK.								
Brecknock	383	343	1	—	32	7	—	1·8
Builth	228	196	—	—	20	4	8	5·3
Crickhowell	643	500	—	—	61	16	66	12·8
Hay	258	181	—	—	27	3	47	19·4
	1,512	1,220	1	—	140	30	121	10·0
CARDIGAN.								
Aberayron	284	239	—	—	34	4	7	3·9
Aberystwith	472	400	—	—	49	14	9	4·9
Cardigan	349	269	—	—	22	2	56	16·6
Lampeter	226	196	—	—	24	3	3	2·7
Tregaron	215	188	—	—	23	4	—	1·9
	1,546	1,292	—	—	152	27	75	6·6
CARMARTHEN.								
Carmarthen	907	800	2	—	89	7	9	1·8
Llandilofawr	640	511	—	—	63	1	65	10·3
Llandovery	268	236	—	—	26	4	2	2·2
Llanelly	1,851	1,592	1	—	156	41	61	5·5
Newcastle-Emlyn	461	401	—	—	47	5	8	2·8
	4,127	3,540	3	—	381	58	145	4·9
CARNARVON.								
Bangor and Beaumaris	967	841	2	—	82	11	31	4·3
Carnarvon	1,085	821	2	—	146	28	88	10·7
Conway	702	583	1	—	71	1	46	6·7
Pwllheli	473	393	—	—	53	18	9	5·7
	3,227	2,638	5	—	352	58	174	7·2
DENBIGH.								
Llanrwst	318	258	1	—	42	11	6	5·3
Ruthin	302	261	—	—	33	3	5	2·6
Wrexham	2,336	2,029	4	—	224	29	50	3·4
	2,956	2,548	5	—	299	43	61	3·5

App. A. No. 1.

Digest of Vaccination Officers' Returns, 1894.

—	Returns, 1894.							
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.
FLINT.								
Asaph, St.	713	609	7	—	56	1	40	5·8
Hawarden	460	314	4	—	40	2	100	22·2
Holywell	1,271	1,070	1	—	96	51	53	8·2
	2,444	1,993	12	—	192	54	193	10·1
GLAMORGAN.								
Bridgend and Cowbridge	1,826	1,548	3	—	198	39	38	4·2
Cardiff	6,891	5,710	29	—	668	36	448	7·0
Gower	265	207	1	—	29	1	27	10·6
Merthyr Tydfil	4,627	3,916	9	—	497	154	51	4·4
Neath	2,128	1,859	2	—	200	24	43	3·1
Pontardawe	857	757	—	—	80	16	4	2·3
Pontypridd	6,345	5,180	6	—	834	68	257	5·1
Swansea	3,947	3,274	2	—	405	1	265	6·7
	26,886	22,451	52	—	2,911	339	1,133	5·5
MERIONETH.								
Bala	122	105	—	—	12	3	2	4·1
Corwen	403	338	1	—	45	13	6	4·7
Dolgelley	345	292	—	—	39	7	7	4·1
Festiniog	710	594	—	—	71	27	18	6·3
	1,580	1,329	1	—	167	50	33	5·3
MONTGOMERY.								
Forden	376	326	—	—	36	9	5	3·7
Llanfyllin	425	350	—	—	58	9	8	4·0
Machynlleth	230	205	—	—	19	2	4	2·6
Newtown and Llanidloes	589	514	1	—	41	6	27	5·6
	1,620	1,395	1	—	154	26	44	4·3
PEMBROKE.								
Haverfordwest	920	742	1	—	106	30	41	7·7
Narberth	464	395	—	—	46	7	16	5·0
Pembroke	850	731	1	—	83	18	17	4·1
	2,234	1,868	2	—	235	55	74	5·8
RADNOR.								
Knighton	303	89	—	—	48	6	160	54·8
Rhayader	156	120	—	—	13	1	22	14·7
	459	209	—	—	61	7	182	41·2

No. 2.

Inspection of Public Vaccination.

App. A. No. 2.

Inspection of Public Vaccination, 1896.

List (alphabetically arranged) of 299 Unions inspected during the Year 1896, with reference to the Proceedings under the Vaccination Acts, 1867 and 1871, and an Account of the Awards certified by the Board as payable to the respective Public Vaccinators out of County Funds.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union. Minimum.	Range of Awards in each Union. Maximum.	Total Sum awarded in each Union.	Medical Inspector.
			£ s. d.	£ s. d.	£ s. d.	
Aberayron - - -	2	1	—	—	8 3 0	Dr. Thomson.
Aberystwith - - -	4	3	8 6 0	13 13 0	33 5 0	Do.
Albans, St. - -	5	4	0 8 0	8 7 0	14 18 0	Do.
Alnwick - - - - -	7	1	—	—	1 5 0	Dr. Fletcher.
Alston-with-Garrigill -	2	1	—	—	2 12 0	Do.
Amesbury - - -	2	2	6 0 0	12 0 0	18 0 0	Mr. Royle.
Anglesey - - - -	3	3	5 9 0	11 19 0	23 4 0	Dr. Wheaton.
Ashbourne - -	6	5	1 9 0	18 4 0	34 18 0	" Buchanan.
Auckland - - -	9	8	5 3 0	32 12 0	151 3 0	" Mivart.
Axminster - -	8	5	2 18 0	5 17 0	22 6 0	Mr. Royle.
Aylsham - - - -	7	4	1 15 0	2 16 0	8 18 0	Dr. Copeman.
Aysgarth - - -	2	2	2 7 0	3 6 0	5 13 0	" Reece.
Bakewell - - -	8	5	2 3 0	11 16 0	33 9 0	Dr. Buchanan.
Barnet - - - - -	5	3	4 11 0	14 10 0	24 15 0	" Thomson.
Barnsley - - -	6	1	—	—	30 9 0	" Reece.
Barnstaple - - -	11	7	0 12 0	18 19 0	40 5 0	Mr. Royle.
Bedale - - -	4	3	3 5 0	5 2 0	11 15 0	Dr. Reece.
Belford - - - - -	2	1	—	—	3 4 0	" Fletcher.
Bellingham - -	6	2	1 5 0	2 12 0	3 17 0	Do.
Belper - - - - -	9	5	5 19 0	16 18 0	59 3 0	Dr. Buchanan.
Berkhampstead - -	3	3	6 16 0	11 15 0	27 3 0	" Thomson.
Berwick-on-Tweed - -	3	2	6 14 0	11 2 0	17 16 0	" Fletcher.
Bideford - - -	6	5	0 9 0	15 5 0	28 8 0	Mr. Royle.
Billericay - - -	4	4	1 6 0	8 10 0	17 4 0	Dr. Copeman.
Birkenhead - -	3	2	8 14 0	14 13 0	23 7 0	" Wheaton.
Birmingham - -	1	1	—	—	328 14 0	" Barry.

App. A. No. 2.

Inspection of Public Vaccination, 1896.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union. Minimum.	Range of Awards in each Union. Maximum.	Total Sum awarded in each Union.	Medical Inspector.
			£ s. d.	£ s. d.	£ s. d.	
Bishop Stortford - -	7	3	4 13 0	12 2 0	22 0 0	Dr. Thomson.
Blofield - - -	3	2	6 14 0	10 14 0	17 8 0	„ Copeman.
Blything - - - -	8	7	3 15 0	9 3 0	45 18 0	„ Reece.
Bolton - - -	9	10	0 17 0	49 2 0	200 15 0	„ Fletcher.
Bootle - - - -	3	3	3 9 0	9 2 0	17 0 0	Do.
Bosmere and Claydon -	3	2	6 4 0	15 4 0	21 8 0	Dr. Reece.
Brackley - - -	4	3	0 8 0	0 15 0	1 14 0	„ Buchanan.
Bradfield - - -	5	5	4 3 0	11 9 0	48 3 0	„ Bulstrode.
Bradford (Yorks) -	4	4	23 3 0	46 0 0	139 4 0	„ Wheaton.
Braintree - - -	7	7	2 1 0	9 7 0	33 1 0	„ Copeman.
Bramley - - - -	5	5	3 10 0	15 14 0	46 14 0	„ Wheaton.
Brampton - - -	1	—	—	—	—	„ Fletcher.
Bridgend and Cowbridge	7	6	8 4 0	17 15 0	79 17 0	„ Bruce Low.
Bristol - - -	1	—	—	—	—	„ Barry.
Brixworth - - -	5	5	2 0 0	6 5 0	18 7 0	„ Buchanan.
Bucklow - - -	6	5	3 8 0	23 17 0	47 3 0	„ Wheaton.
Buntingford - - -	2	2	2 6 0	6 3 0	8 9 0	„ Thomson.
Burnley - - -	7	5	2 1 0	17 11 0	35 6 0	Do.
Burton-on-Trent - -	8	7	0 13 0	22 8 0	44 4 0	Dr. Wheaton.
Calne - - -	1	1	—	—	12 8 0	Mr. Royle.
Cardigan - - - -	3	2	6 6 0	8 9 0	14 15 0	Dr. Thomson.
Carlisle - - -	5	4	3 3 0	62 4 0	74 14 0	Dr. Fletcher.
Castle Ward - -	7	2	0 18 0	2 19 0	3 17 0	Do.
Chapel-en-le-Frith -	3	1	—	—	17 12 0	Dr. Buchanan.
Cheadle - - -	5	5	4 8 0	13 1 0	34 13 0	„ Wheaton.
Chelmsford - - -	9	8	1 17 0	7 7 0	31 18 0	„ Copeman.
Chertsey - - -	6	6	0 8 0	10 18 0	38 2 0	„ Sweeting.
Chester - - -	3	1	—	—	34 3 0	„ Wheaton.
Chesterfield - -	12	8	2 6 0	33 5 0	140 16 0	„ Buchanan.
Chester-le-Street -	4	3	16 2 0	54 13 0	91 12 0	„ Mivart.
Chippenham - -	6	5	1 7 0	15 1 0	36 17 0	Mr. Royle.
Chorley - - -	5	5	13 8 0	34 0 0	103 16 0	Dr. Thomson.
Clitheroe - - -	5	5	1 13 0	16 1 0	36 5 0	Do.
Cockermouth - -	5	2	2 19 0	22 0 0	24 19 0	Dr. Fletcher.
Colchester - - -	1	1	—	—	38 8 0	„ Copeman.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union. Minimum.	Range of Awards in each Union. Maximum.	Total Sum awarded in each Union.	Medical Inspector.
			£ s. d.	£ s. d.	£ s. d.	
Congleton - -	3	3	5 8 0	18 15 0	42 10 0	Dr. Wheaton.
Cosford - - -	5	4	4 4 0	11 12 0	30 8 0	„ Reece.
Coventry - - -	1	1	—	—	0 14 0	„ Barry.
Crediton - - -	10	7	1 6 0	9 0 0	32 1 0	Mr. Royle.
Cricklade and Wootton Bassett.	3	3	6 5 0	11 16 0	24 14 0	Do.
Croydon - - -	6	4	3 2 0	46 7 0	66 0 0	Dr. Sweeting.
Darlington - -	5	5	2 11 0	24 9 0	38 9 0	Dr. Mivart.
Daventry - - -	6	5	1 16 0	8 3 0	24 12 0	„ Buchanan.
Depwade - - -	8	8	2 4 0	17 16 0	78 7 0	„ Copeman.
Derby - - -	2	—	—	—	—	„ Buchanan.
Devizes - - -	6	5	2 0 0	13 19 0	30 10 0	Mr. Royle.
Dewsbury - - -	13	8	3 3 0	16 14 0	74 12 0	Dr. Reece.
Doncaster - - -	7	6	5 13 0	37 17 0	116 13 0	Do.
Dorking - - -	4	4	0 8 0	7 8 0	17 3 0	Dr. Sweeting.
Downham - -	7	4	7 0 0	13 3 0	37 9 0	„ Copeman.
Dudley - - -	8	8	10 3 0	61 1 0	250 3 0	„ Wheaton.
Dunmow - - -	6	5	2 8 0	4 11 0	19 9 0	„ Copeman.
Durham - - -	5	3	21 16 0	50 0 0	95 15 0	„ Mivart.
Dursley* - - -	3	1	—	—	4 15 0	Mr. Royle.
Easington - -	5	2	24 12 0	58 6 0	82 18 0	Dr. Mivart.
Easingwold - -	5	5	1 14 0	3 14 0	14 5 0	„ Reece.
Easthampstead - -	3	2	6 6 0	7 13 0	13 19 0	„ Bulstrode.
East Stonehouse - -	1	1	—	—	12 14 0	Mr. Royle.
East Ward - - -	6	1	—	—	4 8 0	Dr. Fletcher.
Ecclesall Bierlow -	3	3	4 16 0	42 7 0	78 14 0	„ Reece.
Edmonton - - -	16	11	0 6 0	41 1 0	129 17 0	„ Sweeting.
Epping - - - -	8	5	1 3 0	9 16 0	26 4 0	Mr. Royle.
Epsom - - -	9	6	2 5 0	11 6 0	41 17 0	Dr. Sweeting.
Evesham - -	5	5	1 10 0	21 5 0	39 13 0	„ Wheaton.
Exeter - - -	1	1	—	—	15 18 0	„ Barry.

* Inspected in 1895.

App. A. No. 2.

Inspection of Public Vaccination, 1896.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union. Minimum.	Range of Awards in each Union. Maximum.	Total Sum awarded in each Union.	Medical Inspector.
			£ s. d.	£ s. d.	£ s. d.	
Faith, St.	5	2	0 18 0	2 9 0	3 7 0	Dr. Copeman.
Farnham	7	5	2 17 0	16 2 0	45 19 0	„ Sweeting.
Flegg, East and West	4	2	0 17 0	8 11 0	9 8 0	„ Copeman.
Forden	4	4	6 13 0	11 8 0	31 19 0	„ Wheaton.
Freebridge Lynn	4	1	—	—	6 16 0	„ Copeman.
Fulham	3	3	90 6 0	108 7 0	296 2 0	„ Sweeting.
Fylde, The	5	5	3 10 0	23 11 0	69 5 0	„ Thomson.
Garstang	3	3	6 16 0	9 18 0	25 10 0	Dr. Thomson.
Gateshead	5	4	16 13 0	132 12 0	213 11 0	„ Mivart.
George's, St. (Hanover Square).	3	2	14 5 0	25 1 0	39 6 0	„ Sweeting.
Giles, St., and St. George, Bloomsbury.	1	1	—	—	15 10 0	Do.
Glendale	6	3	1 3 0	5 1 0	8 6 0	Dr. Fletcher.
Glossop	1	—	—	—	—	„ Buchanan.
Godstone	5	3	2 13 0	5 8 0	11 17 0	„ Sweeting.
Goole	4	2	4 13 0	9 7 0	14 0 0	„ Reece.
Gower	3	3	2 7 0	6 2 0	13 18 0	„ Bruce Low.
Greenwich	2	2	39 19 0	101 0 0	140 19 0	„ Sweeting.
Guildford	9	8	3 17 0	12 19 0	60 12 0	Do.
Guiltcross	5	4	5 11 0	11 3 0	34 0 0	Dr. Copeman.
Guisborough	7	4	3 16 0	10 3 0	24 2 0	„ Reece.
Haltwhistle	4	3	0 2 0	1 3 0	1 16 0	Dr. Fletcher
Hambledon	5	4	2 3 0	12 2 0	28 6 0	„ Sweeting.
Hampstead	1	1	—	—	13 0 0	Do.
Hardingstone	3	3	2 2 0	4 14 0	11 6 0	Dr. Buchanan.
Hartismere	5	3	5 11 0	6 10 0	18 5 0	„ Reece.
Hartlepool	3	2	44 18 0	65 6 0	110 4 0	„ Mivart.
Haslingden	5	5	6 12 0	28 2 0	90 9 0	„ Thomson.
Hatfield	3	2	3 1 0	9 6 0	12 7 0	Do.
Hayfield	1	1	—	—	20 17 0	Dr. Buchanan.
Helmsley	2	2	1 0 0	3 0 0	4 0 0	„ Reece.
Hemel Hempstead	4	3	4 1 0	6 19 0	16 19 0	„ Thomson.
Hemsworth	4	2	0 14 0	8 0 0	8 14 0	„ Reece.
Hendon	6	6	1 3 0	55 8 0	97 13 0	„ Sweeting.
Henstead	5	5	1 9 0	2 11 0	9 12 0	„ Copeman.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union. Minimum.	Range of Awards in each Union. Maximum.	Total Sum awarded in each Union.	Medical Inspector.
			£ s. d.	£ s. d.	£ s. d.	
Hertford	5	3	3 7 0	13 14 0	23 16 0	Dr. Thomson.
Hexham	12	4	0 19 0	2 15 0	8 2 0	„ Fletcher.
Highworth and Swindon	4	2	6 13 0	33 6 0	39 19 0	Mr. Royle.
Hitchin	5	4	5 16 0	23 6 0	52 9 0	Dr. Thomson.
Holbeck	2	2	1 7 0	13 12 0	14 19 0	„ Wheaton.
Holborn	5	4	19 5 0	33 3 0	110 6 0	„ Sweeting.
Holsworthy	5	4	2 4 0	8 17 0	17 5 0	Mr. Royle.
Holyhead	3	3	8 7 0	10 7 0	27 2 0	Dr. Wheaton.
Honiton	13	6	1 12 0	16 13 0	45 8 0	Mr. Royle.
Houghton-le-Spring	3	3	15 1 0	18 15 0	51 7 0	Dr. Mivart.
Hoxne	8	4	0 17 0	7 16 0	16 14 0	„ Reece.
Huddersfield	16	10	3 19 0	32 17 0	111 9 0	Do.
Hungerford	5	4	6 4 0	11 17 0	36 0 0	Dr. Bulstrode.
Hunslet	4	4	3 19 0	44 0 0	63 15 0	„ Wheaton.
Huntingdon	5	4	6 2 0	10 5 0	31 13 0	„ Bruce Low.
Ives, St.	5	3	5 6 0	9 9 0	21 17 0	Dr. Bruce Low.
Kendal	9	5	3 7 0	16 19 0	36 10 0	Dr. Fletcher.
Kensington	3	1	—	—	47 19 0	„ Sweeting.
Kettering	4	—	—	—	—	„ Buchanan.
Kingsbridge	7	4	3 9 0	12 3 0	25 10 0	Mr. Royle.
King's Lynn	1	1	—	—	2 15 0	Dr. Copeman.
King's Norton	7	7	2 1 0	75 2 0	169 12 0	„ Wheaton.
Kingston-on-Thames	11	8	2 6 0	32 15 0	69 6 0	„ Sweeting.
Kirkby Moorside	1	1	—	—	6 5 0	„ Reece.
Knighton	5	1	—	—	0 15 0	„ Thomson.
Lampeter	2	2	8 12 0	9 11 0	18 3 0	Dr. Thomson.
Lanchester	3	3	2 8 0	62 5 0	94 8 0	„ Mivart.
Leek	6	5	1 14 0	15 0 0	28 6 0	„ Wheaton.
Leigh	3	3	18 17 0	61 0 0	119 15 0	„ Fletcher.
Lexden and Winstree	10	6	1 6 0	4 19 0	20 10 0	„ Copeman.
Leyburn	6	2	1 8 0	1 16 0	3 4 0	„ Reece.
Lichfield	6	4	0 13 0	23 8 0	43 18 0	„ Wheaton.

App. A. No. 2.

Inspection of Public Vaccination, 1896.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union. Minimum.	Range of Awards in each Union. Maximum.	Total Sum awarded in each Union.	Medical Inspector.
			£ s. d.	£ s. d.	£ s. d.	
Liverpool	3	3	42 15 0	105 18 0	209 18 0	Dr. Fletcher.
Llanfyllin	5	5	5 19 0	9 18 0	41 8 0	„ Wheaton.
Llanrwst	3	2	4 11 0	10 17 0	15 8 0	Do.
Longtown	2	1	—	—	7 9 0	Dr. Fletcher.
Macclesfield	5	4	3 0 0	31 3 0	49 11 0	Dr. Wheaton.
Machynlleth	4	3	4 0 0	7 12 0	18 5 0	Do.
Maidenhead	3	2	2 0 0	21 14 0	23 14 0	Dr. Bulstrode.
Maldon	8	5	1 4 0	8 0 0	19 10 0	„ Copeman.
Malton	6	4	1 11 0	3 5 0	10 0 0	„ Reece.
Manchester	3	3	31 15 0	69 0 0	136 6 0	„ Fletcher.
Market Harborough	6	—	—	—	—	„ Buchanan.
Marlborough	2	2	4 2 0	6 6 0	10 8 0	Mr. Royle.
Mere	2	2	7 0 0	11 17 0	18 17 0	Do.
Merthyr Tydfil	10	10	7 6 0	64 2 0	259 17 0	Dr. Bruce Low.
Middlesbrough	4	2	5 7 0	45 10 0	50 17 0	„ Reece.
Mitford and Launditch	8	6	0 18 0	19 4 0	54 10 0	„ Copeman.
Morpeth	9	—	—	—	—	Dr. Fletcher.
Mutford and Lothingland.	3	2	21 14 0	52 0 0	73 14 0	„ Reece.
Neath	6	4	15 19 0	39 17 0	111 1 0	Dr. Bruce Low.
Neots, St.	6	4	3 14 0	11 5 0	24 14 0	Do.
Newbury	3	2	4 6 0	20 4 0	24 10 0	Dr. Bulstrode.
Newcastle-on-Tyne	3	4	34 3 0	95 0 0	219 9 0	„ Barry.
Newton Abbot	13	8	4 10 0	27 8 0	93 10 0	Mr. Royle.
Newtown and Llanidloes.	4	3	5 10 0	23 9 0	41 15 0	Dr. Wheaton.
Northallerton	4	4	0 6 0	5 1 0	9 10 0	„ Reece.
Northampton	4	2	0 13 0	0 16 0	1 9 0	„ Buchanan.
Northwich	5	4	19 9 0	33 10 0	98 13 0	„ Wheaton.
Norwich	2	1	—	—	9 16 0	„ Copeman.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union. Minimum.	Range of Awards in each Union. Maximum.	Total Sum awarded in each Union.	Medical Inspector.
			£ s. d.	£ s. d.	£ s. d.	
Oakham - - -	3	2	4 2 0	7 17 0	11 19 0	Dr. Buchanan.
Okehampton - - -	6	4	6 0 0	13 12 0	32 13 0	Mr. Royle.
Olave, St. - - -	3	3	19 0 0	50 2 0	100 17 0	Dr. Sweeting.
Ongar - - -	4	3	4 4 0	6 17 0	15 16 0	Mr. Royle.
Orsett - - -	5	5	1 11 0	8 17 0	23 7 0	Do.
Oundle - - -	4	2	2 6 0	9 6 0	11 12 0	Dr. Buchanan.
Ouseburn, Great - -	4	1	—	—	9 2 0	„ Wheaton.
Paddington - -	1	1	—	—	106 11 0	Dr. Sweeting.
Pateley Bridge - -	2	1	—	—	18 2 0	„ Wheaton.
Penistone - - -	3	3	1 15 0	10 4 0	18 10 0	„ Reece.
Penrith - - -	6	3	4 1 0	5 14 0	14 7 0	„ Fletcher.
Pershore - - -	5	5	1 13 0	14 19 0	36 15 0	„ Wheaton.
Peterborough - -	7	5	2 15 0	45 2 0	77 15 0	„ Buchanan.
Pewsey - -	5	5	2 9 0	10 0 0	32 3 0	Mr. Royle.
Pickering - - -	3	3	0 13 0	3 10 0	5 11 0	Dr. Reece.
Plomesgate - -	6	5	4 8 0	7 12 0	30 2 0	Do.
Plymouth - -	1	—	—	—	—	Mr. Royle.
Plympton St. Mary -	5	5	2 17 0	10 14 0	34 14 0	Do.
Pontardawe - -	2	2	27 12 0	36 12 0	64 4 0	Dr. Bruce Low.
Pontefract - -	7	7	1 9 0	17 1 0	51 10 0	„ Reece.
Pontypridd - -	9	5	5 15 0	79 13 0	200 17 0	„ Bruce Low.
Poplar - - -	4	4	20 10 0	87 6 0	194 11 0	„ Sweeting.
Potterspury - -	4	3	0 19 0	14 3 0	18 10 0	„ Buchanan.
Preston - - -	4	4	11 2 0	90 15 0	177 12 0	„ Thomson.
Reading - - -	1	1	—	—	101 2 0	Dr. Bulstrode.
Reeth - - -	2	2	3 6 0	3 8 0	6 14 0	„ Reece.
Reigate - - -	4	4	2 17 0	12 15 0	29 15 0	„ Sweeting.
Rhayader - -	2	1	—	—	9 1 0	„ Thomson.
Richmond (Surrey) -	3	3	10 3 0	26 13 0	47 3 0	„ Sweeting.
Richmond (Yorks) -	5	4	2 6 0	8 1 0	19 3 0	„ Reece.
Risbridge - - -	5	4	2 5 0	14 11 0	26 7 0	Do.
Rochford - -	6	3	1 17 0	9 12 0	17 17 0	Dr. Copeman.
Rothbury - - -	6	3	1 0 0	2 8 0	5 15 0	„ Fletcher.

App. A. No. 2.

Inspection of Public Vaccination, 1896.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union. Minimum.	Range of Awards in each Union. Maximum.	Total Sum awarded in each Union.	Medical Inspector.
			£ s. d.	£ s. d.	£ s. d.	
Rotherham - -	11	7	3 8 0	34 1 0	99 13 0	Dr. Reece.
Royston - - -	5	3	6 7 0	14 15 0	31 18 0	„ Thomson.
Runcorn - - -	4	4	4 5 0	25 10 0	47 10 0	„ Wheaton.
Ruthin - - -	3	3	4 5 0	8 5 0	19 19 0	Do.
Saddleworth -	1	1	—	—	0 19 0	Dr. Reece.
Salford - - -	4	3	20 15 0	77 12 0	124 6 0	„ Fletcher.
Salisbury - - -	5	3	4 6 0	11 7 0	24 8 0	Mr. Royle.
Samford - - -	4	2	3 1 0	4 1 0	7 2 0	Dr. Reece.
Saviour, St. - - -	5	5	32 2 0	64 17 0	240 1 0	„ Sweeting.
Scarborough - -	6	4	1 7 0	1 16 0	6 11 0	„ Reece.
Sedgefield - - -	4	4	9 1 0	22 7 0	70 2 0	„ Mivart.
Selby - - -	4	3	1 8 0	9 18 0	16 17 0	„ Reece.
Shardlow - - -	8	4	2 0 0	30 15 0	56 15 0	„ Buchanan.
Shipston-on-Stour -	6	4	3 6 0	9 0 0	24 18 0	„ Wheaton.
Shoreditch - - -	3	2	20 19 0	38 6 0	59 5 0	„ Sweeting.
Skipton - - -	8	2	4 9 0	5 8 0	9 17 0	„ Wheaton.
South Molton - -	10	6	1 9 0	9 19 0	29 13 0	Mr. Royle.
South Shields - -	4	3	14 15 0	97 0 0	189 8 0	Dr. Mivart.
Stepney - - -	1	1	—	—	63 16 0	„ Sweeting.
Stockport - - -	5	5	1 13 0	19 16 0	63 17 0	„ Wheaton.
Stockton - -	4	2	14 4 0	16 0 0	30 4 0	„ Mivart.
Stoke Damerel - -	2	1	—	—	18 5 0	Mr. Royle.
Stokesley - - -	4	4	1 12 0	3 15 0	11 17 0	Dr. Reece.
Stoke-upon-Trent -	5	5	5 10 0	32 19 0	123 9 0	„ Wheaton.
Stourbridge - -	7	5	6 9 0	54 3 0	154 3 0	Do.
Stow - - -	8	3	1 9 0	5 12 0	11 6 0	Dr. Reece.
Strand - - -	1	1	—	—	11 18 0	„ Sweeting.
Sudbury - - -	7	5	1 2 0	17 7 0	42 0 0	„ Reece.
Sunderland - -	5	5	23 17 0	77 0 0	181 2 0	„ Mivart.
Swansea - - -	5	4	27 1 0	66 3 0	181 8 0	„ Bruce Low.
Tadcaster - - -	5	4	0 14 0	22 17 0	47 6 0	Dr. Reece.
Tamworth - - -	3	3	1 17 0	13 10 0	28 12 0	„ Wheaton.
Tarvin - - -	4	3	4 1 0	12 12 0	23 7 0	Do.
Tavistock - - -	8	7	3 8 0	16 2 0	51 7 0	Mr. Royle.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union. Minimum.	Range of Awards in each Union. Maximum.	Total Sum awarded in each Union.	Medical Inspector.
			£ s. d.	£ s. d.	£ s. d.	
Teesdale - - -	6	3	5 4 0	13 19 0	27 4 0	Dr. Mivart.
Tendring - - -	8	5	4 16 0	20 1 0	50 6 0	„ Copeman.
Thetford - - -	6	6	2 1 0	14 9 0	42 18 0	Do.
Thirsk - - -	7	5	0 7 0	1 14 0	5 0 0	Dr. Reece.
Thomas, St. - -	15	14	0 18 0	18 15 0	76 13 0	Mr. Royle.
Thorne - - -	6	3	2 18 0	5 10 0	12 13 0	Dr. Reece.
Thrapston - -	5	2	1 10 0	1 13 0	3 3 0	„ Buchanan.
Tisbury - - -	3	2	4 8 0	8 5 0	12 13 0	Mr. Royle.
Tiverton - - -	13	9	0 10 0	11 15 0	29 2 0	Do.
Torrington - -	5	5	2 19 0	9 2 0	26 2 0	Do.
Totnes - - -	13	6	2 7 0	16 13 0	40 11 0	Do.
Towcester - -	4	4	2 0 0	5 19 0	14 18 0	Dr. Buchanan.
Toxteth Park - -	2	2	55 0 0	70 12 0	125 12 0	„ Barry.
Tregaron - - -	2	2	4 7 0	12 4 0	16 11 0	„ Thomson.
Tynemouth - -	7	3	24 2 0	38 0 0	88 18 0	„ Fletcher.
Uppingham - -	4	2	1 10 0	6 0 0	7 10 0	Dr. Buchanan.
Uttoxeter - -	5	5	1 1 0	7 16 0	16 14 0	„ Wheaton.
Wakefield - -	6	6	12 2 0	61 12 0	204 1 0	Dr. Reece.
Wangford - - -	2	1	—	—	6 16 0	Do.
Wantage - - -	6	6	4 0 0	10 14 0	42 18 0	Dr. Bulstrode.
Ware - - -	8	6	0 11 0	14 6 0	36 5 0	„ Thomson.
Warminster - -	5	4	2 10 0	9 8 0	19 4 0	Mr. Royle.
Warrington - -	3	3	7 14 0	154 5 0	206 2 0	Dr. Fletcher.
Watford - -	4	4	4 4 0	13 19 0	37 3 0	„ Thomson.
Weardale - - -	5	5	1 5 0	9 5 0	28 12 0	„ Mivart.
Wellingborough -	5	2	0 4 0	0 12 0	0 16 0	„ Buchanan.
Welwyn - - -	1	1	—	—	4 17 0	„ Thomson.
West Derby - -	7	7	27 0 0	161 14 0	482 8 0	„ Fletcher.
West Ham - -	9	9	4 14 0	48 3 0	227 2 0	Mr. Royle.
Westminster - -	1	—	—	—	—	Dr. Sweeting.
West Ward - - -	4	3	2 4 0	2 19 0	7 13 0	„ Fletcher.
Wetherby - - -	6	2	2 4 0	4 0 0	6 4 0	„ Wheaton.
Wharfedale - -	4	3	7 11 0	17 5 0	34 13 0	Do.

APP. A. No. 2.

Inspection of Public Vaccination, 1896.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union. Minimum.	Range of Awards in each Union. Maximum.	Total Sum awarded in each Union.	Medical Inspector.
			£ s. d.	£ s. d.	£ s. d.	
Whitby	4	1	—	—	1 4 0	Dr. Reece.
Whitechapel	1	1	—	—	177 14 0	„ Sweeting.
Whitehaven	6	6	2 0 0	44 1 0	134 8 0	„ Fletcher.
Wigan	10	5	28 2 0	61 8 0	223 15 0	Do.
Wigton	7	6	3 12 0	17 4 0	45 17 0	Do.
Willesden*	2	—	—	—	—	Dr. Sweeting.
Wilton	4	3	5 2 0	11 11 0	22 4 0	Mr. Royle.
Windsor	3	3	7 6 0	30 2 0	60 11 0	Dr. Bulstrode.
Wirral	4	3	5 17 0	7 14 0	20 9 0	„ Wheaton.
Wokingham	4	3	7 13 0	12 14 0	28 1 0	„ Bulstrode.
Wolstanton and Burslem	3	3	20 19 0	30 9 0	78 15 0	„ Wheaton.
Woodbridge	4	1	—	—	9 0 0	„ Reece.
Wortley	4	3	3 11 0	30 11 0	44 19 0	Do.
Wrexham	5	5	4 0 0	68 4 0	137 1 0	Dr. Wheaton.
Yarmouth, Great	2	2	18 5 0	31 6 0	49 11 0	Dr. Copeman.
Total	1,486	1,073	—	—	15,110 19 0	

* Willesden only just formed (out of Hendon Union) at date of inspection.

App. A. No. 3.

National Vaccine Establishment.

No. 3.

Statistics of the National Vaccine Establishment and Educational Vaccination Stations.

I.—Staff at end of March 1896.

N.B.—The Stations named in *italics* are Educational Vaccination Stations authorised by the Local Government Board.

Description of Vaccinator.	Name of Vaccinator.	Vaccination Stations.	Days and Hours of Attendance.
Vaccinators supplying lymph for the public service and salaried from the Parliamentary grant.	1. Dr. R. Cory - -	*Surrey Chapel* -	Tues., Thurs.; 2.
	2. Mr. Joseph Loane -	*Tottenham Court Chapel.*	Mon., Wednes.; 1.
Parochial and other Vaccinators not salaried from the Parliamentary grant, but contributing lymph at a fixed rate of payment.	1. Dr. A. C. Clarke -	*Salford* - -	Thursday; 2.
	2. Dr. Edmund Robinson	*Birmingham* -	Tuesday; 11.
	4. Mr. N. E. Roberts -	*Liverpool* - -	Tuesday; 1.
	4. Mr. J. Hawthorn -	*Newcastle-on-Tyne.*	Wednesday; 3.
	5. Dr. A. E. Cope - -	*Westminster* -	Monday; 10.
	6–7. Mr. E. C. Greenwood	*Marylebone* -	Tuesday; 2. Wednesday; 10.
	8. Mr. J. Loane - -	*Whitechapel* -	Wednesday; 11.
	9. Mr. Frederick Holmes -	*Leeds* - -	Tuesday; 2.30.
	10. Dr. Edward Lynes -	Coventry -	Tuesday; 12.
	11–12. Mr. R. H. Henderson.	*Glasgow* -	Monday; 12. (Women). Thursday; 12. (Men).
	13. Mr. J. F. Staines -	*Endell Street* -	Tuesday; 10.
	14. Mr. W. Skinner -	*Sheffield* - -	Tuesday; 3.
	15. Dr. G. A. Miskin -	Waterloo - -	Tuesday; 2.
	16. Dr. J. B. Buist - -	*Edinburgh* -	Thursday; 3.
	17. Dr. F. Cadell - -	*Edinburgh* -	Tuesday; 12.
	18. Dr. R. Cory - -	*St. Thomas's Hospital.*	Wednesday; 11.30.
	19. Mr. J. W. Nicol -	*Glasgow West* -	Monday; 12.
	20. Dr. William A. Budd -	*Exeter* - -	Thursday; 3.
	21. Mr. R. G. McKerron -	*Aberdeen* - -	Wednesday; 2.30.
	22. Mr. J. Ll. Treharne -	*Cardiff* - -	Tuesday; 12.
Teachers of Vaccination not supplying lymph.	Dr. W. Husband -	*Edinburgh* -	Wednes., Sat.; 12.
	Mr. G. S. Page - -	*Bristol* - -	Wednesday; 10.
	Mr. V. A. Jaynes -	*Horsleydown* -	Wednesday; 3.
	Dr. A. N. Montgomery	*Dublin* - -	Tues., Fri.; 10.
	Dr. R. Cory - -	*Cambridge* -	Friday; 11.

App. A. No. 3.

National Vaccine Establishment.

II.—Animal Vaccine Station.

The Animal Vaccine Station is at 95, Lamb's Conduit Street, where Dr. R. Cory and Mr. T. S. Stott attend for the Vaccination of Children on Tuesdays and Thursdays, at 10.30 a.m.

III.—Sources and Amount of Lymph Supply in 1896.

N.B.—The Stations named in *italics* are Educational Vaccination Stations authorised by the Local Government Board.

Description of Vaccinator.	Vaccination Stations.	Number of Vaccinations performed at the Stations respectively.		Number of Charges of Lymph supplied from the Stations respectively.	
		Primary.	Re-vaccinations.	Charged Ivory Points.	Charged Tubes each estimated as equal to 10 Ivory Points
Vaccinators salaried from the Parliamentary grant.	1. *Surrey Chapel*	136	17	—	—
	2. *Tottenham Court Chapel.*	275	14	—	73
	Total -	411	31	—	73
Parochial and other Vaccinators not salaried from the Parliamentary grant, but contributing lymph at a fixed rate of payment.	1. *Salford* - -	143	—	—	—
	2. *Birmingham* -	3,226	185	—	586
	3. *Liverpool* -	470	7	—	67
	4. *Newcastle-on-Tyne.*	458	7	—	8
	5. *Westminster* -	426	19	—	18
	6–7. *Marylebone*	1,172	15	—	—
	8. *Whitechapel* -	1,848	—	—	760
	9. *Leeds* - -	633	5	—	—
	10. Coventry -	276	5	—	—
	11–12. *Glasgow** -	38	—	—	4
	13. *Endell Street* -	116	—	—	55
	14. *Sheffield* - -	393	1	—	—
	15. Waterloo -	1,156	2	—	1,838
	16. *Edinburgh* -	286	1	—	—
	17. *Edinburgh†* -	417	3	—	223
	18. *St. Thomas's Hospital.*	204	1	—	—
	19. *Glasgow West-*	448	1	—	82
	20. *Exeter* - -	829	172	—	—
	21. *Aberdeen* -	286	5	—	—
	22. *Cardiff‡* -	731	16	—	28
	Total -	13,556	445	—	3,669
	Grand Total -	13,967	476	—	3,742

* For one month only. † For seven months only. ‡ For nine months only.

III.—Sources and Amount of Lymph—*continued.*

During the year additional supplies (to the extent of 3,716 charged tubes) were obtained from the following gentlemen:—

Dr. R. S. Archer, Everton.
Mr. J. Bark, Kirkdale.
Dr. F. Cadell, Edinburgh.
Dr. R. F. Cook, Gateshead.
Mr. A. Meeson, Toxteth Park.
Dr. G. A. Miskin, Kennington.

IV.—Distribution of Human Lymph, 1896.

Number of applications:	
From Medical Practitioners in England and Wales	2,921
,, ,, ,, Scotland	84
,, the Navy and from the Emigration Department	49
,, India and the Colonies	42
,, Diplomatic and other Foreign Services	14
Supplies sent out:—	
Charged capillary tubes	6,289

V.—Distribution of Calf-Lymph, 1896.

Number of applications	1,938
Supplies received:—	
Charged ivory points	14,658
,, capillary tubes	91
Supplies sent out:—	
Charged ivory points	13,196
,, capillary tubes	91

No. 4.

App. A. No. 4.

On the Operations of the Animal Vaccine Establishment, 1896-97; by Dr. Cory.

Report on the Operations of the Animal Vaccine Station at Lamb's Conduit Street, during the Year 1896–97; by Dr. Cory.

During the year, 1st April 1896 to the 31st March 1897, 265 calves were received at Lamb's Conduit Street. Of these, 260 (males, 211; females, 49) were vaccinated for the purposes of the station, other three were vaccinated for other purposes, and two were rejected as unfit for vaccination purposes.

The aggregate weight on reception at Lamb's Conduit Street of the 260 calves was, males 69,544 lbs., females, 15,143. On dismissal from the station the weights were respectively 75,821 lbs. and 16,512 lbs., so that during retention for vaccination purposes calves of both sexes gained considerably in weight, males by an average of 29·75 lbs., females by an average of 27·94 lbs. Of the above calves, 256 were vaccinated with lymph directly derived from other calves and four were vaccinated with calf lymph which had been stored. In 256 calf-to-calf operations, 17,444 insertions produced 16,110 vesicles, whereas 278 insertions made with preserved lymph, produced only 182 vesicles, yielding rates of insertion success respectively of 92·35 and 65·47 per cent. No material difference in the results of calf-to-calf vaccinations was observed whether the lymph used was from calves vaccinated 96, or from calves vaccinated 120, hours previously; in both cases the rate of insertion successful was practically 92·35 per cent.

Primary Vaccinations.—During the year, 6,336 persons received primary vaccinations at the station, five separate insertions of lymph being made in the case of each. Of these persons, 3,236 were males and 3,100 females. Of these vaccinations, 5,827 were done with calf-to-arm lymph, and all but 17 of those persons who returned for inspection, succeeded at the first attempt, and in no case was a third attempt at vaccination requisite. The amount of insertion success obtained by each of three several operators was as follows:—Of 329 persons primarily vaccinated with fresh lymph by Mr. Stott, 10 failed to return for inspection. Of the remaining 319, 251 were on examination found to have taken in five places, 32 in four, 11 in three, 12 in two, 4 in one, and in 9 vaccination was not successful on the first attempt. Mr. Stott's insertion success rate therefore was 90·53 per cent.

Of 410 persons primarily vaccinated with fresh lymph by Dr. Savory, acting for Mr. Stott or myself in the absence of one or other of us, 6 failed to return for inspection. Of the remaining 404, 351 were found to have taken in five places, 33 in four, 9 in three, 6 in two, 3 in one, and in two primary vaccination was unsuccessful on the first attempt. Dr. Savory's insertion success rate was therefore 95·49 per cent.

Of 5,133 persons primarily vaccinated by myself with fresh lymph, 67 who failed to return for inspection, and other 6, all of whom were operated on for the cure of nævi, are not taken into account in these statistics.

Of the 5,060 persons remaining, 4,852 were found to have taken in five places, 129 in four, 34 in three, 24 in two, and 15 in one, while in 6 cases vaccination proved unsuccessful on the first trial; the resulting insertion success rate being 98·58 per cent.

Ten persons were primarily vaccinated by students.

Besides these primary vaccinations, which were performed with fresh lymph, Mr. Stott performed 63 with glycerinated calf lymph, which was

supplied to the station by the Board's Medical Officer, and I myself performed 391 such vaccinations with glycerinated calf lymph from several sources.

App. A. No. 4.

On the Operations of the Animal Vaccine Establishment, 1896-97; by Dr. Cory.

Re-vaccinations.—These during the year numbered 414. Mr. Stott performed 12, Dr. Savory 52, various students 13, and I myself 337. Of the latter, 313 were successful in five places, 9 in four, 7 in three, and one was unsuccessful at the first trial; other 7 did not return for inspection.

My insertion success rate therefore in re-vaccinations was 98·30 per cent. Mr. Stott's success rate among his 12 cases, which returned for inspection, was 98·15 per cent., and Dr. Savory's, among his cases which returned for inspection, was 98·43 per cent.

In all, 49 cases returned to the station after "inspection" on account of some abnormal course of their vaccinations. In the majority of cases the reason for return was sore arm, which was almost invariably the result of ignorant treatment of the vesicle or of the scab. For the rest, there were seven cases of transient eruption and five cases of axillary abscess following sore arm.

There was one death from erysipelas after vaccination. The infant was vaccinated on the 9th April, and the death took place on the 7th May.

There was one other death attributed to convulsions. The infant was vaccinated on the 25th June, and the death took place on the 6th July.

No. 5.

App. A. No. 5.

Amended Instructions to Public Vaccinators.

ORDER of LOCAL GOVERNMENT BOARD amending INSTRUCTIONS to PUBLIC VACCINATORS; 7th January 1897.

To the Guardians of the Poor of the several Poor Law Unions in England and Wales;—
And to all others whom it may concern.

Whereas by an Order issued by Us, the Local Government Board, and dated the 28th of February, 1887, it was provided that all vaccinations and inspections under Contract should be performed in accordance with the "Instructions for Vaccinators under Contract" contained in the Schedule appended to such Order;

And whereas by paragraphs (5) and (6) of the Instructions contained in the said Schedule certain directions were given to Vaccinators with regard to lymph to be used or furnished for vaccination;

And whereas it is expedient that further provision should be made in the matter as herein-after mentioned:

Now therefore, We hereby Order and Direct that the said Order dated the Twenty-eighth day of February, One thousand eight hundred and eighty-seven, shall be amended by the substitution for the above-cited paragraphs (5) and (6) of the Instructions to Vaccinators contained in the Schedule to such Order of the following paragraphs; namely,—

"(5.) Endeavour to maintain in your district such a succession of "cases as will enable you to vaccinate with liquid lymph directly "from arm to arm at each of your Contract attendances. When "stored lymph, whether humanised lymph or calf lymph, is used, "it should be preserved either *dry* on ivory points, thickly charged "and constantly well protected from damp; or *liquid* in tubes, "hermetically sealed at both extremities. With all stored lymph "caution is necessary, lest in time it have become inert, or "otherwise unfit for use.

"(6.) Consider yourself strictly responsible for the quality of whatever "lymph you use or furnish for vaccination. In storing "lymph, be careful to keep separate the charges obtained from "different subjects, and to affix to each set of charges the name, "or the number in your Register, of the subject from whom the "lymph was derived. Keep such note of all supplies of lymph, "whether humanised lymph or calf lymph, which you use or "furnish as will always enable you to identify the origin of the "lymph. Do not employ lymph supplied by any person who does "not keep exact record of its source."

Given under the Seal of Office of the Local Government Board, this Seventh day of January, in the year One thousand eight hundred and ninety-seven.

(L.S.) HENRY CHAPLIN,
President.

HUGH OWEN,
Secretary.

INSTRUCTIONS for VACCINATORS under Contract, as prescribed by Orders of the Local Government Board, dated 28th February 1887, and 7th January 1897.

(1.) Except so far as any immediate danger of small-pox may require, vaccinate only subjects who are in good health. As regards infants, ascertain that there is not any febrile state, nor any irritation of the

bowels, nor any unhealthy state of skin; especially no chafing or eczema behind the ears, or in the groin, or elsewhere in folds of skin. Do not, except of necessity, vaccinate in cases where there has been recent exposure to the infection of measles or scarlatina, nor where erysipelas is prevailing in or about the place of residence.

(2.) In all ordinary cases of primary vaccination, make such insertions of lymph as will produce at least four separate good sized vesicles or groups of vesicles, not less than half an inch from one another. The total area of vesiculation on the same day in the week following the vaccination should not be less than half a square inch.

(3.) Direct that care be taken for keeping the vesicles uninjured during their progress, and for avoiding afterwards the premature removal of the crusts. Do not use any needless means of "protection" or of "dressing" to a vaccinated arm; but if, in a particular case, you find reason for means of "protection" or of "dressing" define the material and the manner of use of the appliance best adapted to the case, avoiding all such as cannot readily be destroyed and replaced whenever they become soiled.

(4.) Enter all cases in your Register on the day when you vaccinate them, and with all particulars required in the Register up to and including the column headed "Initials of persons performing the operation." Enter the results on the day of inspection. Each of these entries must be attested by the initials of the person who inspects the case. In cases of primary vaccination, register as "successful" only those cases in which the normal vaccine vesicle has been produced; in cases of re-vaccination, register as "successful" only those cases in which either vesicles, normal or modified, or papules surrounded by areolæ, have resulted. When any operation (whether vaccination or re-vaccination) has to be repeated owing to want of success in the first instance, it should be entered as a fresh case in the Register.

(5.) Endeavour to maintain in your district such a succession of cases as will enable you to vaccinate with liquid lympth directly from arm to arm at each of your contract attendances. When stored lymph, whether humanised lymph or calf lymph, is used, it should be preserved either *dry* on ivory points, thickly charged and constantly well protected from damp; or *liquid* in tubes, hermetically sealed at both extremities. With all stored lymph caution is necessary, lest in time it have become inert, or otherwise unfit for use.

(6.) Consider yourself strictly responsible for the quality of whatever lymph you use or furnish for vaccination. In storing lymph, be careful to keep separate the charges obtained from different subjects, and to affix to each set of charges the name, or the number in your Register, of the subject from whom the lymph was derived. Keep such note of all supplies of lymph, whether humanised lymph or calf lymph, which you use or furnish as will always enable you to identify the origin of the lymph. Do not employ lymph supplied by any person who does not keep exact record of its source.

(7.) Never take lymph from cases of re-vaccination. Take lymph only from subjects who are in good health, and, as far as you can ascertain, of healthy parentage; preferring children whose families are known to you, and who have elder brothers or sisters of undoubted healthiness. Always carefully examine the subject as to any existing skin disease, and especially as to any signs of hereditary syphilis. Do not take lymph from children who have any sort of sore at or about the anus. Take lymph only from well characterised uninjured vesicles.

App. A. No. 5.

Amended Instructions to Public Vaccinators.

Take it at the stage when the vesicles are fully formed and plump. Do not take it from a vesicle around which there is any conspicuous commencement of areola. Open the vesicles with scrupulous care to avoid drawing blood. Take no lymph which, as it issues from the vesicle, is not perfectly clear and transparent or which is thin and watery. From a well-formed vesicle of ordinary size, do not, except under circumstances of necessity, take more lymph than will suffice for the immediate vaccination of five subjects, or for the charging of seven ivory points, or for the filling of three capillary tubes; and from larger or smaller vesicles, take only in like proportion to their size. Never squeeze or scrape or drain any vesicle, and do not use lymph that has run down the skin. Be careful never to transfer blood from the subject you vaccinate to the subject from whom you take lymph.

(8.) Scrupulously observe in your inspections every sign which tests the efficiency and purity of your lymph. Note any case wherein the vaccine vesicle is unduly hastened or otherwise irregular in its development, or wherein any undue local irritation arises; and if similar results ensue in other cases vaccinated with the same lymph, desist at once from employing it. Consider that your lymph ought to be changed, if your cases, at the usual time of inspection, on the day week after vaccination, show any conspicuous areolæ round their vesicles.

(9.) Keep in good condition the lancets or other instruments which you use for vaccinating, and do not use them for any other purpose whatever. When you vaccinate, have water and a napkin at your side, with which invariably to cleanse your instrument after one operation before proceeding to another. Never use an ivory point or capillary tube a second time either for the conveyance or for the storage of lymph; but when points or tubes have once been charged with lymph and put to their proper use, do not fail to break or otherwise destroy them.

N.B.—Supplies of lymph are furnished to medical practitioners on personal application at the Office of the Local Government Board, Whitehall, London, between the hours of 12 and 2; or by letter addressed as follows:—

To
The Secretary,
Local Government Board,
Whitehall,
London, S.W.

National Vaccine Establishment.

No. 6.

On the PREPARATION and STORAGE of GLYCERINATED CALF LYMPH; by DRS. THORNE THORNE and MONCKTON COPEMAN.

APP. A. No. 6.

On the Preparation and Storage of Glycerinated Calf Lymph; by Drs. Thorne Thorne and Copeman.

INTRODUCTION addressed by the MEDICAL OFFICER to the Right Honourable HENRY CHAPLIN, M.P., President of the Local Government Board.

SIR,

SHORTLY after the issue of the Report of the Royal Commission on Vaccination last autumn I received your instructions that I should, together with Dr. Monckton Copeman, visit certain cities in different countries on the continent of Europe, with a view of obtaining information as to the methods adopted, by the respective authorities and others concerned, in the distribution of vaccine lymph derived from the calf, more especially in reference to the preparation, storage, and distribution of glycerinated calf lymph.

The necessary visits were commenced in December of last year, but owing to the fact that in some of the countries to be visited public vaccination is practically limited to certain months of the year, commencing with the spring, it was found impossible to complete the inspections until quite recently. In eliciting information as to the methods adopted in each of the countries visited, we held especially in view two points to which the Royal Commission gave prominence in their Report. The first of these—one which the Commissioners put "in the forefront" is the recommendation in section 437 of their Report "that parents should not be required to submit their children to "vaccination by means of any but calf lymph." The second, which is referred to in section 448, is concerned with experiments which Dr. Copeman made and announced to the International Congress of Hygiene which met in London in August 1891, as to the effect of the storage of vaccine lymph in glycerine. "The conclusions at which he arrives," say the Commissioners, "are that the addition of glycerine, whilst it "leaves the efficacy of the lymph undiminished, or even increases it, "tends to destroy other organisms"; and they add that "The question "is one a further investigation of which is obviously desirable."

The places visited by us were Paris, Brussels, Berlin, Dresden, Cologne, and Geneva; and in submitting to you an account of the operations which came under our notice in each of these cities, I beg leave to make the following observations.

It will be noted that in each of the countries concerned, vaccination with calf lymph has become the habitual, if not the universal practise. In some, indeed, we were informed that, although vaccination with humanised lymph is not definitely prohibited under any statute or regulation, yet resort to such lymph by any medical practitioner having official responsibility to the Government is altogether discouraged.

In only one of the places visited—namely, Paris—did we find that vaccination was carried out under official sanction with crude calf

lymph, and even there the process was limited to vaccination direct from calf-to-arm, all lymph stored for distribution being glycerinated calf-lymph.

The circumstances of Paris in the matter of vaccination direct from the calf deserve consideration, because they have a certain similarity to those which may be encountered in this country, in case the use of calf lymph should become habitual. Thus, we were informed that if vaccination had, during past years, been limited to the use of glycerinated calf lymph, stored in tubes or otherwise, it would have been found difficult, amongst certain classes of a population which heretofore had only known of stored humanised lymph, to convince persons whose vaccination it was desirable to secure that the lymph proposed to be used on them was really calf lymph, not humanised lymph. In order to ensure confidence in this respect, it had been the practice to convey calves to the vaccination stations, or to districts infected with small-pox, and to perform the vaccination direct from calf-to-arm. Perusal of the account which we give as to this practice in the hands of MM. Chambon and Ménard will show that it has been brought to a position of very considerable efficiency.

In all the other countries visited we found that, acting on the indications announced by Dr. Copeman in 1891, the Governments and other authorities concerned had made sustained investigation as to the preparation, storage, and use of glycerinated calf lymph, and had gradually come to adopt that preparation of lymph for official, and in some cases for all, purposes throughout their jurisdictions. Thus, in Germany we were informed that the system of vaccinating direct from the calf had come to be abandoned as completely as that from arm-to-arm, the use of glycerinated calf lymph having become general throughout the Empire.

The reasons for this change have been two. The governing reason has been the confirmation by competent bacteriologists of the results obtained by Dr. Copeman, to the effect that, by the admixture to calf lymph of a 50 per cent. solution of pure glycerine in sterile water, and by subsequent storage of the lymph material in tubes, under due precautions, for a term of several weeks, the preparation remained quite active as vaccine, whilst a very remarkable germicidal effect was produced on extraneous micro-organisms in the lymph, even including certain pathogenic organisms which had been purposely added to the lymph material. The second reason was that, by reason of the admixture referred to, the amount of vaccine procurable from a given calf could be greatly, even enormously, increased, and that, within certain wide limits, this could be done without interfering with the insertion-success following on the use of the lymph. At the Board's Animal Vaccine Establishment it has hitherto not been deemed necessary, nor even expedient, to make one calf serve for more than some 200–300 vaccinations. It is no unusual thing abroad to provide from a single calf an amount of glycerinated lymph that shall serve for from 4,000 to 6,000 vaccinations, and in Berlin we were assured that the glycerinated lymph which was prepared in our presence from one calf would suffice

for no less than 15,000 vaccinations. We brought some of this Berlin lymph to England, and it was used for the purposes of vaccination at intervals of 9, 11, and 37 days after its collection, with the result that in 76 vaccinations performed, in each case by five insertions, its use resulted in a mean insertion-success of 92·0 per cent. Storage of this particular sample for a much longer period did not give satisfactory results. With other preparations of glycerinated lymph, diluted to about one third of the amount of the Berlin sample, and which were used in England at intervals varying from 7 to 31 days after collection and preparation, the insertion-success reached 97, 98, and 99 per cent.; and in the case of 111 vaccinations, all effected with two other supplies of glycerinated lymph, used at intervals of from 7 to 30 days after preparation, the success reached 100 per cent., every insertion of lymph being followed with success. In all these cases the vaccination was performed by means of five insertions.

In every instance we found that the work of collecting, preparing, and storing the glycerinated lymph was carried out with the greatest care; a condition of scientific cleanliness was especially aimed at, and a laboratory, fitted with bacteriological and other scientific apparatus, always formed an essential part of the vaccine institution. The extent to which the desired end of freedom from extraneous impurity was attained depended largely on whether a first attempt to adapt an existing calf station or similar establishment to its new purposes had been maintained, or whether it had been abandoned in favour of an institution constructed especially for the purposes of that which is in the main scientific laboratory work. Several of the stations which we visited are already under condemnation, because of the difficulty of ensuring that freedom from extraneous micro-organisms which should be aimed at during the preparation of the lymph supply; the Cologne station is one of the newest, and may well serve, in its main features, as a type of that which should be aimed at.

The condition of scientific cleanliness to which I have referred extended to such matters as the following: (*a*) the construction and administration of the stabling for the calves; (*b*) the means for washing or bathing calves before their vaccination; (*c*) the construction, cleansing, &c., of the operating rooms; (*d*) the cleansing of the vaccinated surface of the calf with germicidal preparations and sterilised cloths before collection of the lymph; (*e*) the use of clean sterilised outer garments by all officials concerned in the processes carried out; (*f*) the sterilisation of all instruments, &c., employed; and (*g*) the carrying out of the process of admixture of the lymph material or pulp with glycerine, as also its preparation and storage under conditions of laboratory freedom from extraneous organisms.

Further, we found that it was an invariable practice at the stations visited on the Continent not to issue any lymph until a report had been received from a veterinary surgeon, after slaughter of the animal, as to the freedom of the calf furnishing it from disease; in brief, the lymph issued is that of healthy calves only. This practice is mainly with a view of avoiding all risk of conveying tuberculosis along with calf lymph;

App. A. No. 6.

On the Preparation and Storage of Glycerinated Calf Lymph; by Drs. Thorne Thorne and Copeman.

though such risk would, under any circumstances, be a very remote one, seeing that tuberculosis is extremely rare in young bovine animals, and seeing also that the tubercle bacillus, when experimentally added to a mixture of lymph and an aqueous solution of glycerine, rapidly loses its vitality.

The information which we obtained in the course of our visits does not profess to be complete. Much remains to be ascertained by careful scientific research, in order to learn what are the precise conditions under which glycerinated calf lymph can be prepared and stored, so as to secure to the utmost freedom from extraneous, and especially from pathogenic micro-organisms, whilst at the same time retaining to the utmost the undiminished protective value of the lymph material against small-pox. We learned that in every country visited further research is being made in this direction, and in Germany a special commission of medical and bacteriological experts has been appointed by the Government to study and report upon the subject

But the information which is now available in this country, and that which, during the course of our visits abroad, was placed at our disposal with a readiness and a courtesy which calls for an expression of the fullest acknowledgment, suffices to enable me to submit the following conclusions for your consideration :—

1st. It is desirable that vaccination, both primary and secondary, carried out under the auspices of the Government, should be performed exclusively with vaccine lymph derived from the calf.

2nd. There will probably be advantage in retaining, for a time at least, the system of calf-to-arm vaccination at the Board's Animal Vaccine Station for such parents and others as may specially desire it, and for the purposes of comparing its results with those following the use of calf lymph preserved in one or another way.

3rd. The distribution of calf vaccine from the National Vaccine Establishment should be limited to glycerinated or similar preparations of lymph and pulp material, in air-tight tubes, or other glass receptacles.

4th. To give effect to the above it will be requisite that the Board's Animal Vaccine Station should be reorganised, both as regards construction and administration. Notably will it be requisite that it should include a properly equipped laboratory, under the direct supervision of a bacteriological expert.

I have the honour to be,

Sir,

Your obedient servant,

July 1897. RICHD. THORNE THORNE.

REPORT on the RESULTS of an INSPECTION made by Dr. R. THORNE THORNE and Dr. S. MONCKTON COPEMAN as to VACCINATION ARRANGEMENTS adopted in certain EUROPEAN COUNTRIES with special reference to the PREPARATION and STORAGE of GLYCERINATED CALF VACCINE LYMPH. (Prepared by Dr. S. MONCKTON COPEMAN.)

App. A. No. 6.

On the Preparation and Storage of Glycerinated Calf Lymph; by Drs. Thorne Thorne and Copeman.

PARIS.

At Paris we spent several days in inspecting the manner in which the work of obtaining, preparing, storing, and distributing calf vaccine lymph is carried out at the Institut de Vaccine Animale and at the Académie de Médecine respectively.

The Institut de Vaccine Animale.

This establishment is carried on by M. Chambon and Dr. St. Yves Ménard. It is, practically, a private establishment, although the municipality of the city of Paris contract with the directors to carry out all such public vaccinations, within their jurisdiction, as may be necessary.

The Institut de Vaccine Animale, which is situate in the Rue Ballu, consists of what was originally a dwelling-house, with a courtyard opening to the street alongside, and a stable behind, the portion of the courtyard immediately adjoining the stable being covered over and provided with sliding doors, so as to form an operating room when necessary. Rooms in the dwelling-house on the ground floor are set aside as waiting and operating rooms in which persons are vaccinated direct from the calf, while on the first floor are other rooms in which the calf lymph is manipulated, placed in sealed tubes, stored, and distributed.

Stable.—This is a building about 18 feet square, which contains stalls for 10 calves. Each stall is somewhat narrow, but we were informed that this was advantageous, as the animal was thus kept more quiet than would otherwise be the case. Attached to the halter of each animal is a large iron ring which runs on a vertical iron rod let into the wall of the building, above and below. This arrangement was devised in order to prevent the calves from being able to lick the inoculated area of their body, while, at the same time, it does not prevent them from lying down. The floor of the stable, which is formed of roughened bricks, slopes slightly to a shallow drain on either side of a footway between the two rows of stalls. The building is heated artificially by means of hot-water pipes, and its ventilation is aided by means of an extraction shaft containing a lighted gas jet. At the time of our visit the temperature was about 15° C. The walls are covered with glazed tiles, and the floor is laid with bricks which are impervious to moisture. Both walls and floor are occasionally washed down by the aid of a spray of a solution of perchloride of mercury.

Calves.—These animals, which appear to be in every respect well suited for the purpose of lymph propagation, are of a special breed, and are obtained from the Department of Corrèze in the southern half of France. They are all of a uniform reddish-brown colour, with fairly long, soft hair. Their skin, when exposed by shaving, is seen to be particularly smooth and supple, and it varies in colour from pink to a pale shade of brown. For the purpose of keeping free from urine the straw-bed which comes into contact with the surface of the body operated on, only cow-calves are employed, which vary in age from four to six months, the average being about 18 weeks. Prior to being brought to the Institut stable they are kept for about 12 days in a

App. A. No. 6.

On the Preparation and Storage of Glycerinated Calf Lymph; by Drs. Thorne Thorne and Copeman.

quarantine shed in the outskirts of Montmartre. They are all weaned at the age of two months, and they receive no milk or eggs while at the quarantine shed or at the Institut stable, the food of each calf consisting of—

1 litre of crushed oats;
2 litres of bran; and
3 kilos of hay

twice daily, at about 6 a.m. and 4 p.m. At both places water is supplied from the town mains.

The calves cost, on an average, about 125 francs, with an additional 22 francs for travelling, &c., making 147 francs in all. After use, they are sold to a butcher, at a loss of from 30 to 40 francs.

On the day after arrival at the stable, the calves are vaccinated. Injection of tuberculin is not employed, as the directors consider this unnecessary, in view of the fact that immediately after collection of the lymph each calf is sent to the abattoir and slaughtered under the personal supervision of a medical man whose report is awaited before any of the lymph is distributed for use. In the event of any signs of tuberculosis being found, the whole of the lymph derived from this particular animal would be destroyed.

Vaccination of Calves.—For this purpose one or more large tubes of glycerinated lymph, which have been kept for at least a month subsequent to its collection and storage, are employed, the directors considering that better results are thus obtained than if the operation were carried out directly from calf to calf.

For the purposes of the operation the calf is strapped to a tilting table somewhat similar in design to those employed in this country, but the right hind leg of the animal is not elevated, and in consequence the mammary region is not exposed, indeed it is not utilised for inoculation. (*See* Plates I. and II.)

To prepare a surface for the insertion of the lymph the right side of the animal is thoroughly scrubbed with soap and hot water, and then shaved over an area extending between the internal edges of the fore and hind limbs and from some four or five inches below the spinal ridge to the umbilicus. The shaved area is next washed with soap and hot water, then with a hot solution of boracic acid, and, finally, with plain hot water. It is afterwards dried with clean soft cloths.

A number of superficial incisions, each about 1 inch long, are then made in a direction at right angles to the long axis of the body and about a couple of inches one from another. The incisions of the several rows are made *en échelon*. The lancet employed for the purpose has a spear-headed blade, this shape being specially recommended by M. Chambon. Over each incision a drop of glycerinated lymph is allowed to fall from a glass tube, and the drop is rubbed in with the flat portion of the blade of the lancet. The process is carried out by one of the laboratory servants, and is a somewhat lengthy one.

When the lymph has dried, the calf is removed from the table and taken back to its stall.

Collection of Lymph.—The vaccine material is always collected on the sixth day. The calf is once more placed on the table; or, if material is required for immediate use only, it is usually allowed to stand. (*See* Plate III.) The vaccinated area is washed with warm water and dried with clean soft cloths. Each vesicle is now clamped separately, and the crust first removed with a lancet, which is then wiped on a cloth pinned to the front of the clean cotton blouse which the operator has previously donned.

App. A. No. 6.

On the Preparation and Storage of Glycerinated Calf Lymph; by Drs. Thorne Thorne and Copeman.

The vesicle is then thoroughly scraped with the edge of a somewhat blunt lancet, and the resulting mixture of lymph, epithelial tissue, and blood is transferred to a small nickel crucible set in a wide wooden stand on a table close to the operator. The crucible is provided with a cover which is kept over it except at the moment when a further addition is made to its contents. The collection of all the vesicular material obtainable from one calf appears to take about three-quarters of an hour.

To the pultaceous mass contained in the crucible there is added about an equal quantity of glycerine which was described to us as "doubly rectified," but which appeared to be of very thin consistence as compared with the best English glycerine. No accurate measurement of the quantity employed is made.

The mixture of pulp and glycerine is triturated in a mixing machine devised by Dr. Chalybäus, of Dresden; the particular one that we saw being driven by a small electric motor. (A description of this machine by Dr. Chalybäus himself will be found on pages 54–55.)

The mixture, having thus been rendered thin and homogeneous, is received in a clean sterilised nickel crucible placed beneath the machine, but with a view of still further improving its appearance and of removing any extraneous matters, such as hairs, it is afterwards pressed through a small brass-wire sieve consisting of extremely fine gauze into an agate mortar. This is done by means of a bone spoon, and there is left on the surface of the gauze nothing but a very small quantity of epithelial tissue together with a few hairs. The mixture is further triturated in the mortar with an agate pestle, and is then ready for filling into the tubes in which it is distributed.

Storage of Lymph.—The lymph material is next drawn up into a sterilised glass syringe provided with a metal nozzle of such a size that the tubes to be filled can easilybe fitted over it. Slight pressure on the piston of the syringe causes sufficient lymph to enter the tube. Each tube is filled about two-thirds full, and is then placed on a porcelain tray, pending its being sealed. This is done without delay by means of a blow-pipe, the air blast of which is provided by means of a pressure apparatus in one corner of the room. The tube is first tilted until the column of lymph occupies the central portion, and it is then held in a horizontal position, while each end is successively placed in the blowpipe flame, and, when sufficiently melted, drawn out by means of a pair of forceps, and so sealed.

Distribution of Lymph.—The tubes when sealed are placed with a small surrounding of cotton-wool in small light metal tubes provided with a tightly-fitting cover. These cases, if sent out singly, are fitted into a block of wood grooved on one side; being kept in position by a paper label, which is gummed round the block, and which has on one side space for postal address and stamp, and, on the other, directions for use.

A register is kept of persons to whom supplies of lymph are sent, and of the calf from which each supply is derived.

Académie de Médecine.

We also visited the vaccine station of the Académie de Médecine, of which Dr. Hervieux is the director. The general principles on which this institution is conducted are so similar to those which have been set out at length, in the description of MM. Chambon and Ménard's establishment, that it is unnecessary to enter into similar details again. It should be mentioned, however, that at the Académie de Médicine the calves employed were not of the same breed as those

App. A. No. 6.

On the Preparation and Storage of Glycerinated Calf Lymph; by Drs. Thorne Thorne and Copeman.

used at the Institut Vaccinal, neither did the vesicles which we had an opportunity of seeing, on a single visit, appear to be quite equal in character to those which we observed at the latter institution.

Calf-to-Arm Vaccination at Nanterre.

While in Paris we were afforded an opportunity of seeing an extensive series of vaccinations and re-vaccinations, carried out directly from calf-to-arm, at the Nanterre House of Detention. The calf, which arrived at the establishment in a closed van a photograph of which we append (*see* Plate IV.), was brought from the vaccine institute of MM. Chambon and Ménard, and the vaccinations were carried out by M. Chambon and by one of the medical officers to the establishment.

The operations were performed in a small square room having a door at each of two opposite angles; opposite the door of entry the calf was tied up to a post, and, in front of and facing it, an assistant took up his position in order to collect the lymph, by scraping slightly one of the vesicles on the calf's abdomen, to which compression forceps had been applied. On his right hand were placed a tray containing lancets and compression forceps, a rack for holding charged lancets, and a glass bowl containing a pad of cotton-wool floating in perchloride of mercury solution. On either side of him, and so arranged as to be able with ease to reach the tray, sat one of the two operators, each of whom had placed in front of him a chair for the vaccinee.

The male inmates, each with his shirt sleeve on the left arm rolled up to the shoulder, were admitted by the door opposite the calf, an assistant, wearing an ambulance badge, giving the upper part of each person's arm a brisk rubbing with a cloth soaked in boracic acid solution as he entered, the arm being afterwards dried with another cloth. Two or three warders were also in attendance, who so directed the stream of inmates that each operation chair was refilled as soon as vacated.

On an inmate seating himself, the operator took a charged lancet from the rack, with which he made three punctures in an oblique direction, just beneath the skin of the upper arm. The lancet was then dropped into the glass bowl containing the disinfectant, from which, in turn, it was removed by the assistant, who wiped it on a previously sterilised cloth, and the instrument was then recharged.

One assistant was thus able to keep the two operators supplied with charged lancets as rapidly as they were required, and it will be obvious that the whole scheme of operation had been well devised, and was skilfully and expeditiously carried out, when we mention that during our visit no less than 480 vaccinations were performed in the short space of 39 minutes. Most of the vaccinations were re-vaccinations, some of the inmates having been submitted to the same operation on the occasion of previous admissions to this or similar institutions.

Arrangements for Gratuitous Domiciliary Vaccination in the City of Paris.

As already stated, MM. Chambon and Ménard are entrusted, by the municipality of Paris, with the carrying out of arrangements for the vaccination and re-vaccination of the inhabitants; and on receiving information of the occurrence of small-pox in any part of the city, they make domiciliary visits for the purpose of offering vaccination to persons who may be unable or unwilling to attend the public stations.

DOMICILIARY VACCINATION IN PARIS.

(From " L'Illustration " of September 16, 1893.

E 97569.

App. A. No. 6.

On the Preparation and Storage of Glycerinated Calf Lymph; by Drs. Thorne Thorne and Copeman.

The notifications as to the existence of small-pox are at once sent on to MM. Chambon and Ménard, who then make arrangements to attend at the house or neighbourhood in question on the following day; but in the meantime the day and time of attendance are intimated to the inhabitants by means of printed cards having blank spaces for the insertion of the necessary particulars. In Paris each "house," in most of the quarters occupied by the poor and the working classes, is made up of a series of flats, which, again, are subdivided up into dwellings of one or more rooms, the number of persons inhabiting each house being, therefore, much greater than is the case in this country. Each such "house" has a porter's lodge at the entrance, and it is outside this lodge that the notice previously mentioned is displayed, and it is in this lodge also that, at the pre-arranged time, the vaccinations and re-vaccinations are generally performed. For these operations calf lymph is invariably employed, the process being carried out direct from calf-to-arm, a previously vaccinated calf being sent to the house from the Institut Vaccinal in a specially constructed van, of which an illustration is appended (*see* Plate IV.). Occasionally, from want of space in the porter's lodge or other reasons, the calf, after being removed from the van, is allowed to remain in the street, its halter being held by an attendant, while another assistant, taking his seat on a camp stool, proceeds to collect lymph from the inoculated area of the animal's side and abdomen, with the aid of clamp forceps and lancet. Where such procedure is considered necessary, the persons requiring vaccination, whether infants or adults, also are brought out into the street, and the extraordinary spectacle may be witnessed of vaccinations being carried out by the medical staff surrounded by an interested crowd of sightseers.

We append a copy of an engraving which recently appeared in the illustrated supplement to "Le Petit Parisien," in which M. Ménard and his staff are depicted carrying out "public" vaccination under the circumstances described. The drawing was made without the knowledge of M. Ménard, but is substantially correct in its details.

MM. Chambon and Ménard attach much importance to this organisation and practice. They say that, under the immediate influence of existing small-pox, large numbers are willingly submitted, both to primary and secondary vaccination, who would otherwise escape; and they are of opinion that certain classes who might object to be vaccinated with lymph from an unknown source, find all their objections on this score removed when they actually see the calf which serves as vaccinifer.

We were supplied both by Dr. Hervieux and by MM. Chambon and Ménard with samples of the glycerinated lymph, which had been collected and prepared on the occasion of our visits. That which was obtained from the Académie de Médecine was collected on December 10th, 1896. It was used by Dr. Cory at the Board's Animal Vaccine Station for the vaccination of 27 children on December 29th. All the cases were, as usual, vaccinated by means of five insertions of lymph, and the insertion-success obtained was 99·3 per cent.

That obtained from MM. Chambon and Ménard was collected on December 8th, 1896; it was used by Dr. Cory on December 22nd and 31st, and on January 7th, 1897, for the vaccination of 96 children, and every one of the five insertions succeeded in every child.

App. A. No. 6.

On the Preparation and Storage of Glycerinated Calf Lymph; by Drs. Thorne Thorne and Copeman.

Brussels.

At Brussels the propagation, storage, and distribution of calf lymph is carried out at the École Vétérinaire, under the supervision of Professor Degive, the director of that establishment.

The building set apart for the calf-lymph station contains the director's room, a distributing room, an operating and preparation room, and two stables. As, however, we were informed by Professor Degive that the accommodation at present provided is regarded as very insufficient for the purpose, and that a new vaccinal institute is about to be erected, it would serve no useful purpose to enter into a detailed description of the present building.

Stable.—The stable, which is a detached building, contain stalls for six calves, three on either side of a central footway, and the stalls are so arranged that a space is also left between them and the side walls of the building. The stalls are very narrow, and, at the end furthest from the central passage, have two iron uprights fastened to the sides of the stall. Iron rings, which are attached to the animal's halter by means of steel clips, slide up and down the uprights. This arrangement permits the calf to stand up or lie down, but prevents all possibility of its licking the inoculated portion of its body.

The stable is warmed by an iron stove, the temperature at the time of our visit being 15° C. It is ventilated by windows opening inwards in the upper part of the two outside walls, and the removal of vitiated air is further facilitated by four outlet ventilators, each about 6 inches square, and placed just above the floor level, the up-draught being aided by means of gas jets in the outlet shafts.

Calves.—The calves are not of any special breed, and those that we saw did not seem to be so well suited for the purpose of lymph propagation as certain of those thus employed at the Institut Vaccinal in Paris. Another point of difference is that at Brussels male animals are used exclusively; Dr. Degive believing that the finest vesicles are obtained on the scrotum. For the first four days after their reception the calves are kept in a separate "quarantine" stable. On the day prior to vaccination they are swung, by means of a belly band and an arrangement of pulleys, into a wooden, zinc-lined, tank bath, capable of containing sufficient water to cover nearly the whole body. The temperature of the water is kept at about 30° C. In this bath the calves are scrubbed all over with soft soap. After removal from the bath, the skin is thoroughly dried with cloths, and the animal is then placed in the stable adjoining the operating room.

Each calf is injected with 1½ cubic centimetres of tuberculin on the day prior to vaccination, but Dr. Degive considers this an unnecessary precaution for the reasons that (*a*) tuberculosis is very rare in calves, and that (*b*) no lymph is distributed until the animal from which it was obtained has been slaughtered, and necropsy has made it certain that the animal was not the subject of tuberculosis. In the event of tubercle being found the lymph would be destroyed.

The *age* of the calves employed averages from 10 to 14 weeks, but animals four months old are sometimes used.

The *food* of the calves consists principally of milk and eggs, each calf receiving, in 24 hours, 12 litres of milk and four eggs, together with a little hay, which is placed in each stall for the animal to eat if it is so disposed.

Inoculation of Calves.—The calf is fixed, by means of ropes, to a tilting table of somewhat primitive construction, the right hind limb

being elevated, as is usually done in England. A leather blinker is also fastened over the head. The right side and the abdomen are washed with soap and water with which lysol is mixed, and the surface is then shaved. The skin is afterwards washed with warm boracic acid solution, then with hot boiled water, and it is subsequently dried with cloths which are sterilised by steam just previous to use. All instruments are also boiled in a solution of boracic acid. The lancets employed are similar in form to those devised by M. Chambon, while the compression forceps appeared to be of somewhat old design and needlessly heavy.

The operator and his assistants all wear white blouses, which, just previous to use, have been sterilised in an autoclave.

Incisions, about two or three inches in length, are made at right angles to the long axis of the body, all over the shaved area of the skin, and also on the scrotum; the average number for each calf being about 150. The incisions are made with a dry lancet, and are placed *en échelon*, and about a couple of inches distant one from another.

The lymph employed for vaccination is kept in stock for, at least, six weeks previous to its use; it consists of vesicular pulp which, at the time of collection, is simply mixed with twice its weight of glycerine and is then kept in a glass tube, the mouth of which is closed with a cork fixed with paraffin until required. Just before it is needed for inoculation of a calf the pulp is ground up in a small agate mortar with a further small quantity of glycerine. The resulting emulsion is well rubbed into each separate incision on the skin by means of a thin ivory instrument resembling a small paper-knife; the edge being passed up and down each incision several times.

Collection of Lymph.—On the sixth day the calf is again fixed on the operating table, and the vaccinated area is once more washed with warm water and dried with sterilised cloths. The lymph required for stock purposes is then first collected. For this purpose compression forceps are applied to each vesicle separately, and the crust is first carefully removed with the edge of a lancet. These crusts are collected in a watch-glass, and are employed for the vaccination of children. The vesicular pulp is next removed by scraping with the lancet, and the material is collected in another watch-glass or Petri dish and weighed. Glycerine is added to it from a stock bottle to the extent of about twice the weight of the pulp, but the amount is only roughly estimated, no actual measurement or weighing being deemed necessary. The pulp and glycerine are stirred together, and are at once placed in a glass tube of such a size as to ensure its being almost entirely filled with the material available; it is then fastened down by means of a glass stopper or cork, without further manipulation.

When sufficient pulp for stock purposes has been obtained, the remainder of the vesicles are scraped off with a Volkmann's spoon, and the material is mixed, as before, with glycerine, without trituration.

The glycerine employed was stated to be of English manufacture, but was much thinner than that usually sold in this country, giving the impression, indeed, that it had been considerably diluted with water. It is sold as being "chemically pure."

Storage and Distribution.—Just as is the case with what is termed the "stock" supply, this material is ground down in a mortar, with more glycerine, before being distributed for use.

According to the amount required, the emulsion is either stored in tiny stoppered bottles, which are supposed to contain enough material for 25, 50, or 100 vaccinations; or, when a less quantity is desired, the material is placed in a slight excavation on the surface of a small glass

plate about 1 inch square, and a plate of a similar size, but not hollowed out, is slid over it. The edges are sealed with paraffin, and the whole is wrapped round, first with tin foil, and then with paper.

The small bottles are fitted into blocks of wood, bored with holes for the purpose, in order that the parcel may go safely through the post.

To each package is attached, by string, a doubled card, which can be addressed outside, and which, inside, has spaces for particulars as to number of vaccinations carried out, the number of insertions in each case, and the amount of success which results.

The lymph which was supplied to us by Professor Degive was used for certain bacteriological investigations; hence we have no record as to its success when used for the purposes of vaccination. But, from a number of returns made by different vaccinators to Professor Degive, we found that these showed a high per-centage of insertion-success.

While at Brussels, we also visited the Municipal Vaccination Station, of which Dr. Janssens, the Medical Officer of Health, is director.

We were informed that the station, which consists of a waiting and an operating room, is open daily, but that, practically, no children are brought for vaccination during the winter months. This was unfortunately the case at the time of our visit, so that we had no opportunity of seeing the work in actual operation.

The lymph employed is received in small glass-stoppered bottles from Professor Degive, of the École Vétérinaire.

Berlin.

The Animal Vaccine Establishment at Berlin, of which Dr. Schultz is the director, is situated in the Central Meat Market, on the outskirts of the city.

The station consists of three parts connected with each other: (1) A large stable containing stalls for the calves; (2) a work-room fitted with two tilting tables, somewhat similar to those in use in England, on which the calves are vaccinated, or the "lymph" collected; and (3) the director's room, in which the lymph is triturated, glycerinated, and stored. This room contains cupboards and benches, and is fitted with all the necessary bacteriological apparatus, glassware, and instruments; the latter being made entirely of metal, so as to admit of their being readily sterilised.

Calves.—Cow-calves are almost invariably used, as less likely, when they lie down, to foul with their urine the vaccinated area of the abdomen than are males. The calves employed are usually from about six weeks to three months old. They are received 48 hours before they are required for vaccination, and are at once injected with half a gramme of tuberculin. If their temperature should rise above 41° C. during the next 24 hours they are not employed for the production of lymph. The calves are fed on a mixture of milk, eggs, and corn flour, of which the milk is always sterilised prior to use.

Vaccination of Calves.—When placed on the table, the abdomen is shaved from the vulva to the umbilicus, and a portion of the inside of each thigh is also shaved. The surface of skin thus exposed is carefully scrubbed with soap and water, washed with a solution of corrosive sublimate 1-1000th, and then again washed with boiled water. The operator also washes his hands carefully, using carbolic

soap, and before commencing to operate puts on a white cotton blouse over his coat. The calf's skin having been dried with a clean towel, long parallel incisions are then made over the whole length of the abdomen, and also over the shaved portion of the thighs. These incisions, which are made with a blunt knife, so as to draw as little blood as possible, are hardly a quarter of an inch apart, and are about 18 to 24 inches in length on the surface of the abdomen. If any blood appears along the line of the incisions it is removed by means of sterilised blotting paper. A few grammes of stored glycerinated lymph, prepared some weeks or months previously, are next poured on the abdomen and spread over the incised lines with the back of a scalpel.

Collection of Lymph.—On the fifth day (120 hours after vaccination) the calf is again placed on the table. After a thorough cleansing of the skin in the same manner as before, absolute alcohol is poured over the vaccinated area. When the alcohol has evaporated the surface is treated with ether, which is supposed to exert a bactericidal, in addition to its anæsthetic action. Then the skin is put on the stretch and scraped, in the direction of the incisions, with a sharp spoon. The spoon is taken over each portion of the vaccinated surface *once* only, so as to avoid, as far as possible, admixture of blood; and by this means all the epithelium which has undergone vesicular changes caused by the action of the specific virus is removed in long strips of about one-eighth inch wide. Compression forceps are not needed, and the whole operation is completed in a few minutes.

Preparation of Lymph.—The whole mass of epithelial tissue removed by the spoon is collected and emptied into a glass Petri dish, and afterwards it is weighed in a delicate balance. Seven times the weight of cold boiled water and a similar quantity of glycerine are then weighed out separately. A small portion of the water is added to the dish containing the tissue scrapings, and after being stirred together the mixture is passed between the small porcelain or glass rollers of a mixing mill, invented by Dr. Döering. In this mill the epithelium is gradually broken up and, as this is being accomplished, the remainder of the water is gradually added; the entire bulk of the mixture being subsequently passed through the mill a second time.

Formerly it was the custom at this station to add both glycerine and water to the epithelium partly before and partly during its passage through the mill.

For some months past, however, it has been the practice not to add the glycerine until *after* the material has been twice passed through the mill. This grinding process is effected with more difficulty in the absence of glycerine; but the reason for the alteration is that much of the lymph is now centrifugalised, a method of procedure which would be unduly prolonged if the specific gravity of the emulsion operated on had previously been increased by the addition of glycerine. The centrifuge at present in use is a small two-armed instrument worked by hand; its use involving the employment of an extra assistant for at least a couple of hours. At the end of this time the minute shreds of epithelium contained in the mixture have settled into a compact mass at the bottom of the tube, and the supernatant fluid is only very slightly opalescent. This is decanted off, and an amount of glycerine equal in weight to that of the water previously employed is intimately mixed with it, after which the resulting "lymph" is stored in a stock bottle fitted with an india-rubber stopper and cap; or it is put up in small glass tubes of 1 cc. capacity, each of which contains, according to Dr. Schultz, sufficient material for 100 vaccinations. The amount of vesicle pulp

App. A. No. 6.

On the Preparation and Storage of Glycerinated Calf Lymph; by Drs. Thorne Thorne and Copeman.

collected from a single calf varies from 10 to 15 grammes. This, when intimately mixed with the usual amount of dilute glycerine, is calculated to provide sufficient material for the vaccination of, at least, 15,000 persons.

This process of centrifugalisation is as yet only tentative and experimental. The appearance of the "lymph" is thought to be improved by its adoption, and, when tested by the method of plate cultivation, it is found to be freer from "extraneous" microbes than is an equivalent amount of the emulsion when tested before treatment in the centrifuge. Objection, however, to the employment of the method might be based on this freedom if, as there is every reason for believing, the microbe specific to vaccine is present in a far greater amount within the cells of the vaccinated dermis than in the intercellular lymph spaces. Even if free in the fluid portion of the mixture, and of exceptionally minute size, the continued action of the centrifuge must tend in time to remove them, just as is found to be the case with other microbes which may be present.

The amount of glycerine and water employed in the preparation of vaccine material has been considerably increased during the past twelve months, the relative proportions being at present:—

Epithelial pulp - - - -	1 part.
Glycerine - - - - -	7 parts.
Boiled water - - - -	7 „

All "lymph" is now tested bacteriologically by means of plate cultivations, before being distributed. This is done in consequence of the recommendation of a scientific committee of which Professor Koch was a member and which has recently been sitting at Berlin to inquire into the whole subject of the collection, purification, and preservation of vaccine lymph.

Season of Calf Inoculations.—Inoculations are only carried out in the months of May, June, and July. The calves being themselves vaccinated with stored glycerinated lymph, it is not necessary to keep going a continuous series; and in these three months sufficient lymph is manufactured for use during the whole year throughout one of the largest of the eight districts into which the kingdom of Prussia is divided for vaccination purposes.

Disposal of Calves.—After collection of lymph, the calves are sold to the Jewish Rabbi to be slaughtered for food. We were informed that a *larger price* is given for them than is ordinarily the case with calves brought to the Central Meat Market, owing to the fact that they are in such fine condition as the result of good feeding while at the station.

Glycerinated calf-lymph collected and prepared as above stated on the occasion of our visit on January 10th, 1897, was used by Dr. Cory for the vaccination (*a*) of 30 children on January 19th, with an insertion success of 97·1 per cent.; (*b*) of six children on January 21st, with an insertion success of 86·6 per cent.; (*c*) of 40 children on February 25th, with an insertion success of 92·3 per cent.; and of 33 children on March 4th, with an insertion success of 67·5 per cent. This sample of glycerinated lymph was again used after having been kept until six months had elapsed since the date of its preparation. It was then found that its activity on vaccine lymph had practically disappeared. It is right to state in this connexion that at the Board's Animal Vaccine Station there are, as yet, no means of storing lymph elsewhere than in the somewhat high temperature at which the operating rooms are maintained.

Dresden.

The Animal Vaccine Institute, of which Dr. Chalybäus is director, is situated in the northern suburbs of Dresden. It consists of a small two-storied building, containing, on the ground floor, an operating room and three other rooms, while the whole of the first floor is utilised as a dwelling for the caretaker. Adjoining this building is a small stable containing stalls for the calves.

Dr. Chalybäus informed us, however, that the Animal Vaccine Institute was hardly arranged in accordance with modern requirements, having been established more than 12 years ago, when the present methods of preparing lymph were not in vogue.

The stable in which calves are placed on arrival contains two stalls and a tank bath in which the animals are thoroughly washed before use. The calves are lifted into and out of this tank by means of belly-bands attached to a system of pulleys fixed to the ceiling. After having been dried with cloths they are vaccinated and then placed in another stable on the opposite side of the house.

The calves are bedded in their stalls on fine wood shavings, which are said to have the advantages of being clean, dry, and comfortable.

The operating room is about 20 feet square, and contains two tables. One of these is for calves; the other, of larger size, and fitted with mechanical arrangements for tilting and raising, is for young bullocks, which are occasionally employed for purposes of vaccination, when either an extra amount of lymph is required or when it has been impossible to obtain the required number of calves.

By preference, Dr. Chalybäus employs cow-calves of from six to eight weeks old.

The calf table is an oblong, shallow trough of wood, provided with straps and with *two* iron uprights at one end, to which the hind limbs of the calf are fixed in a V-shape. This method of fixation, however, enables the animal to struggle to such an extent as to raise its hind-quarters completely off the table. After having been shaved, and before vaccination, the animal's skin is washed with soap and hot water containing lysol. The soap suds having been washed off with more water, and the skin dried with a cloth, benzine is poured over the surface to render it more aseptic, and is rubbed in with sterile sponges of gauze, which are kept for use in a sterilised glass-stoppered bottle. Lengthy incisions are next made with a blunt scalpel, in the long axis of the body, over the inside of the thighs and over the whole surface of the abdomen from the vulva to the umbilicus; also over the lower ribs. Glycerinated lymph *which has been stored in sealed tubes for about three months* is next rubbed in over the area of the incisions with the flat surface of a small trowel-shaped instrument.

We were informed that much difficulty is experienced in this establishment in obtaining calves suitable for purposes of vaccination, as throughout Saxony it is the custom to slaughter these animals for food at a very early age, sometimes within a few days of birth. This being so, calves have to be imported from a distance, most of those employed by Dr. Chalybäus coming from Berlin or Hamburg. They are obtained by a local cattle-dealer, who charges 20 marks for their use, and who removes them for slaughter immediately after collection of the lymph.

Calf-to-arm vaccination is never employed in Saxony as it is thought to be undesirable to use lymph from an animal until a necropsy has shown it to have been entirely free from disease.

App. A. No. 6.

On the Preparation and Storage of Glycerinated Calf Lymph; by Drs. Thorne Thorne and Copeman.

Collection of Lymph.—The lymph, or rather the vesicle pulp, is collected after an interval of four complete periods of 24 hours. The skin is first washed with white soft soap and hot water, the operation being carried out with the aid of a large house-painter's brush. Such crusts as have formed are removed as far as possible with the edge of an ordinary metal tea-spoon, after which glycerine is poured over the skin and rubbed in with gauze sponges.

The pulp is collected by scraping with a Volkmann's spoon, but as Dr. Chalybäus goes over the same surface again and again, a not inconsiderable amount of blood becomes mixed with the epithelial scrapings. The raw surface of the abdomen is afterwards dusted over with fine oatmeal.

The pulp thus collected is weighed and is then run through a mixing machine invented by Dr. Chalybäus, of which a special description, written by him, together with an illustration, is appended to this report. The necessary motive power is supplied from a small water motor fixed beneath the floor of the room.

After being ground up in the machine, four times the amount of a mixture of glycerine and sterilised water (water 3 parts, glycerine 1 part) is added to the vesicle pulp, and the whole is then run through once again to ensure thorough admixture. The resulting emulsion is received into a porcelain mortar placed beneath the machine. The mortar is removed when all the material has passed through, and its contents are then taken up by suction into tubes of somewhat large calibre which, when filled, are closed at either end by means of sealing wax.

Dr. Chalybäus considers that one gramme of glycerinated emulsion is sufficient for 80 vaccinations. The vesicle pulp obtained from a single calf affords from 50 to 75 grammes of the glycerinated emulsion; or, in other words, enough for the vaccination of from 4,000 to 6,000 persons.

Glycerinated calf-lymph collected and prepared by Dr. Chalybäus on the occasion of our visit on January 12th, 1897, was used by Dr. Cory for the vaccination of 15 children on January 21st. The children were, as usual, vaccinated by means of five insertions, and every insertion gave a successful result.

(*Translation.*)

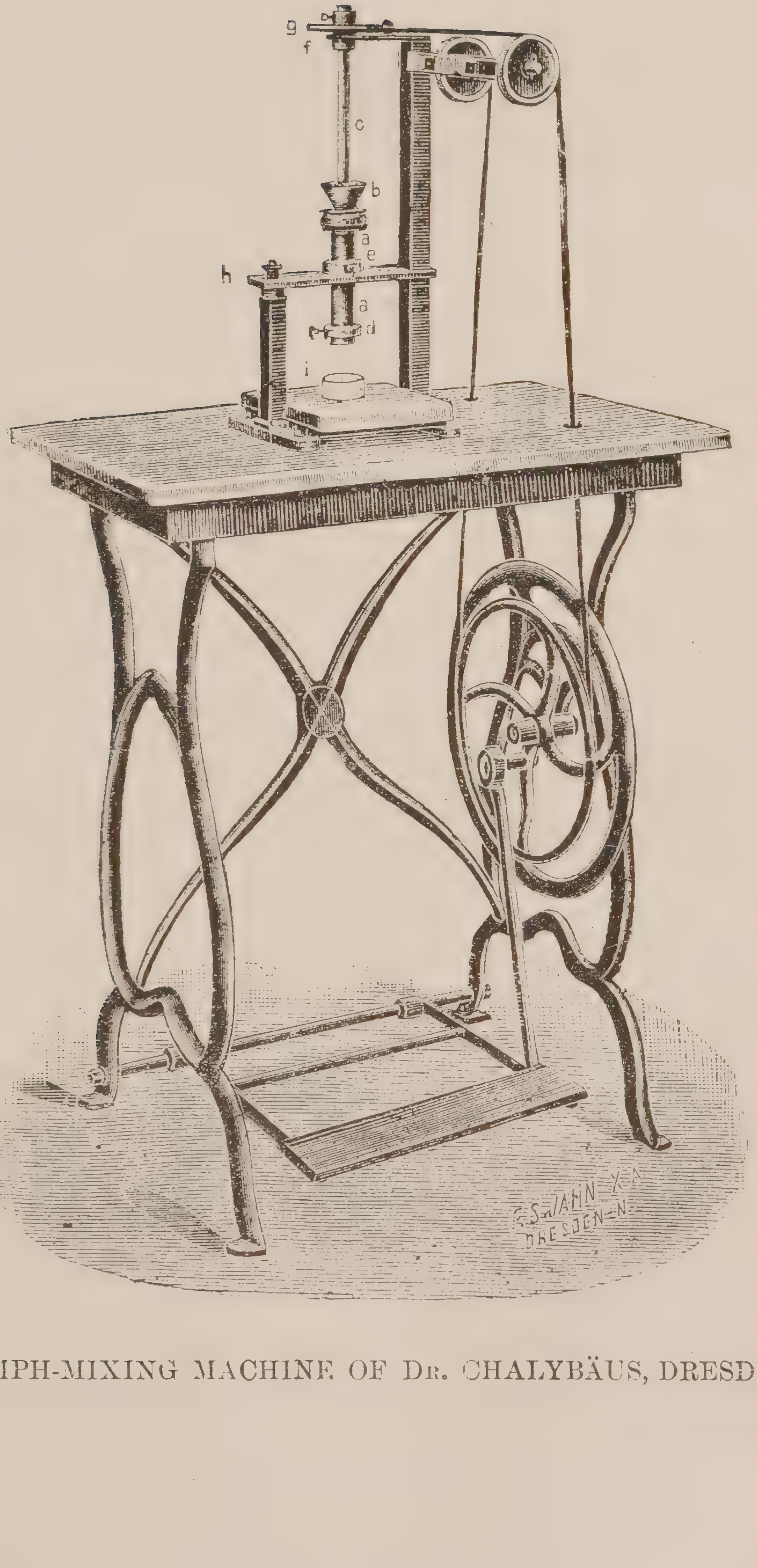
Report of the Royal Institute for Vaccination in Dresden.

About the Technique of Preparing Animal Lymph, by Dr. Chalybäus, Dresden.

As a rule the exclusive use of animal lymph for vaccination has been everywhere adopted, whilst the use of human lymph, taken from children, has been almost entirely abandoned, and public Institutes for vaccination prepare only calf lymph. The preparation of animal lymph needs special contrivances, because the lymph scraped out of the "small-pox of a calf," in order to make it available, must be triturated and ground to a fine pulp, and with the addition of glycerine, turned into a thin and homogeneous emulsion. When triturated in a dish or bowl this operation takes, for the quantity of lymph obtainable from one calf, three hours time, and cannot therefore be done by the physician himself; nevertheless, great care must be taken, as it is unwise to leave that part of the preparation of lymph to a common workman, who cannot be properly and continuously watched.

As far back as 1889 I constructed a machine for triturating lymph, which stood the test of use in the Institute of this country and of those of many others. In 1893 the machine was improved. It is now fitted upon the marble table of a sewing engine, and moved either by foot or, still better, by means of a small hydraulic, steam, or electric motor.

A cylinder formed out of two equal parts, having in its inside threads of a screw, is attached to the shank of a column; a close fitting spindle,



LYMPH-MIXING MACHINE OF Dr. CHALYBÄUS, DRESDEN.

On the Preparation and Storage of Glycerinated Calf Lymph; by Drs. Thorne Thorne and Copeman.

likewise provided with threads of a screw, turns in the cylinder. Through a funnel the raw lymph is put into the upper end of the cylinder; in turning the spindle the lymph is rubbed and ground to the utmost, and leaves the cylinder on the lower opening, dropping into a glass dish.

By means of this contrivance the preparation is completed in about 15 minutes, although the work is done in a far better way than as usually in a dish. The lymph, consisting of coherent and liquid parts, is thoroughly rubbed, not only squeezed and turned into homogeneous emulsion. It does not lose its natural colour, nor does it get warm.

The apparatus is made of steel bronze, and its parts, comprising cylinder, spindle, and funnel, can easily be separated and disinfected in boiling water or otherwise.

The trituration occurring whilst the apparatus is closed—the opening of the funnel is closed by a cover of glass—no dust can enter, and should a calf hair accidentally have dropped into the lymph it can be removed whilst the lymph slowly drops out of the cylinder. No loss of lymph can occur, because the machine retains none of the material with which it is fed.

The machine can be obtained through the Royal Institute for Vaccination, in Dresden, price, 200 marks. Every machine is tested by the president of the above-mentioned institute, and a certificate is granted to each one sent out, as a proof of its fitness.

Directions for using the Machine for triturating Lymph, invented by Dr. Chalybäus.

1. *To take the machine to pieces*, slack the screw in claw *f* on which the driving-wheel *g* and spindle *c* is attached. Open the claws and remove the spindle and driving wheel *g* taking care not to let the former drop. Take off funnel *b*, slack screw of lower clamp *d*, and unscrew the middle clamp *e*, holding the cylinder in the left hand. Take the cylinder out of the support *h*. In order to separate the two parts of cylinder, use a small piece of wood by inserting it in the hollow, but care must be taken not to drop the parts when separated. Remove the driving-wheel from the spindle, and clean it, as well as the spindle and funnel, with a brush, and sterilise in boiling water.

2. *To put the machine together*, first join both parts of the cylinder, put on the lower clamp and turn its screw a little, pass the cylinder vertically through the support and place the funnel on the top of the cylinder. Then screw the driving-wheel on the upper part of the cylinder, open the claws and insert the spindle so far that the claws grasp the spindle close under the driving-wheel, shut the claws and screw tight. Bring the lower ends of spindle and cylinder exactly in a line and fasten the lower clamping screw. Finally, adjust the belt on the driving-wheel.

3. *To put the machine in motion*, move the fly-wheel *k* outwards, and to avoid friction use vaseline for lubricating the moving parts. It is advantageous first to run some glycerine through the cylinder, after which the lymph is placed in the funnel and the cover adjusted. If preferred, however, glycerine can be added to the lymph, and the mixture passed through the machine. The finished lymph leaves the lower end of the cylinder and drops into a small glass vessel *i*.

Cologne.

The buildings provided for this Institution are the most recent of their kind in Germany, and, as we were informed previous to our visit, all the fittings are of the most modern description.

We visited the Institution with Dr. Vanselow, where we were also met by the assistant director, the veterinary surgeon attached to the staff, and certain other gentlemen.

Dr. Vanselow presented us with a reprint of a paper written by him, showing a description of the buildings, illustrated with blocks giving the elevation and ground plans. We append a translation of this, so that it is unnecessary here to enter into any details as to structure.

Stable.—The calf stable, which adjoins the collecting room, contains 10 stalls, one of which is reserved for any calf used for experimental purposes, while another is merely a pen forming the platform of a weighing machine. The sides and ends of the stalls are formed solely of a series of iron bars, painted grey, and they are of such narrow width as to make it impossible for a calf to turn round, it being thus prevented from licking the inoculated area of its abdomen. Each stall is provided with a gate at either end, opening outwards, and bears a numbered label of iron. The flooring of the whole stable is formed of cement concrete, over which in each stall is placed a wooden rack or platform which is raised about three inches from the floor. These racks are formed of wooden splines about two inches square, placed close together, the upper edges of each spline being slightly rounded. On these racks the calves stand or recline, no bedding of hay or straw being employed.

Calves.—The calves range usually from about six to eight weeks old. They are purchased in the meat market which immediately adjoins the establishment. The calves required for the current week are bought on Monday, and they are sold on the following Saturday, after their slaughter and the collection of lymph on the previous day; so that the stable is always empty from Saturday to the following Monday. The calves are kept under observation in the stable for 24 hours after their reception, and are vaccinated on Tuesday. Only three complete days are allowed for the progress of the local results of vaccination. On Friday the animal is slaughtered in a small slaughter-house opening off from the stable, and immediately it is dead the carcase is brought into the collecting room on a trolley (*see* Plate V.), the abdomen washed, and the epithelial pulp of the vaccination area is removed by means of a sharp spoon.

Vaccination of Calves.—We did not see the process of vaccinating the calves, but we learnt that it was carried out in an exactly similar fashion to that employed at the Berlin and Dresden stations, namely, by long parallel incisions over which glycerinated lymph is rubbed by means of a spatula or other flat-bladed instrument. The lymph employed for the vaccination of calves is always kept for a period of at least six weeks after glycerination, in order to ensure that it shall be as free as possible from extraneous organisms before it is used to vaccinate the calves.

After collection of the lymph pulp, and while it is being prepared for use, the carcase of the calf is taken back to the slaughtering room, where it it skinned and opened. The internal organs are removed and brought in on trays to be examined by the veterinary surgeon. In the event of his forming the opinion that any of the organs presented any condition indicative of disease, the lymph derived from the animal in question would be at once destroyed.

In view of this precautionary measure it is not deemed necessary to test the calves by the injection of tuberculin prior to their vaccination.

Collection and Preparation of Lymph.—The greatest amount of vaccine is collected during the months of March, April, and May, when from six to eight calves are employed every week. For the remainder of the year the weekly vaccination of one or two calves is found to be sufficient to supply all the lymph required for human vaccinations and revaccinations in the Cologne district.

App. A. No. 6.

On the Preparation and Storage of Glycerinated Calf Lymph; by Drs. Thorne Thorne and Copeman.

In the preparation of the lymph material the epithelial pulp from the vaccinated area is removed by scraping with a Volkmann's spoon, and is received in a small glass dish. In this it is weighed, after which it is turned out into a mortar and thoroughly triturated; at first without any addition of water or glycerine; later, small quantities of water are gradually added to the extent of *five* times the weight of pulp. The mixture having been ground up still further, double the quantity of glycerine is finally incorporated. Thus, at the time of our visit, five grammes of pulp having been collected from one calf, the composition of the finished emulsion was as follows:—

Pulp	- - -	5 grammes.
Water	- - -	25 ,,
Glycerine	- - -	50 ,,

Dr. Vanselow informed us that this quantity would suffice for the vaccination of 5,000 children.

The emulsion is afterwards forced into small bottles and tubes by means of a machine actuated by water power. This machine, which is manufactured by a Vienna firm, appears to be decidedly useful and convenient, and is capable of being worked in connexion with any form of pressure apparatus.

The small bottles are of different sizes, and contain lymph sufficient for 50, for 100, and for 150 vaccinations respectively. The bottles and their corks are all of them sterilised prior to use.

We were struck with the numerous precautions which are taken in this institution to ensure thorough asepsis throughout the various stages of lymph production. Thus, in the collecting room, the flooring is of cement concrete, the walls are lined internally for about half their height with opaque glass tiles, the upper half being of parian cement. The shelves are of glass supported on iron brackets, and the surface of all tables consists of thick slabs of glass over green cloth, the glass being removable if necessary. The Institution is furnished throughout with electric light, and sterilised hot water is supplied as needed from a small apparatus affixed to the wall of the collecting room. India-rubber pipes used in connexion with the hot-water apparatus and the pressure apparatus employed for filling tubes are kept in a strong solution of carbolic acid when they are not in use. The director and all his assistants wear linen covers over their clothes; but only the sleeves, which are detachable, appear to be sterilised prior to each occasion on which they are used.

On the first floor of the building is a bacteriological laboratory, which is reached from the collecting room by an iron spiral staircase. It is fitted up with an autoclave, incubators, &c. But owing to the director being engaged in private practice, he has no time to work in this laboratory, which is, therefore, only used when it is desired to sterilise cloths, instruments, or glass-ware.

With the lymph and pulp material collected and glycerinated in our presence on January 16th, 1897, Dr. Cory vaccinated 34 children on January 19th with an insertion success of 98·8 per cent., and 21 children on February 11th with an insertion success of 93·3 per cent.

(*Translation.*)

The Royal Lymph Station for the Rhine Province at the New City Cattle and Slaughtering Establishment, Cologne; by Sanitary Councillor, Dr. Vanselow, Director.

The public Institution for the preparation of animal lymph to meet the needs of the Rhine Province and the Hohenzollern districts was

erected in Cologne in 1889. The rooms at the old slaughtering establishment which were used until 1895 were extremely defective, being narrow, damp, and dark, and rendered any practically uniform arrangement impossible. In building the new cattle and slaughtering establishment the provision of a suitable annexe for the production of lymph was borne in mind from the very first; and so the present institution originated, which meets all the demands of hygiene and may justly be regarded as the prototype of such institutions.

The annexe is situate at one end of a large cattle shed, both having a common partition. The main front faces the north, so that all the rooms, as there are windows only in the front, receive their light equally distributed from that direction. The building is very solidly built, but under-cellared only, and to the smallest extent, on the eastern side. As, however, the whole of the ground was filled in, and only absolutely dry and permeable material employed, there is no fear of any dampness of the rooms.

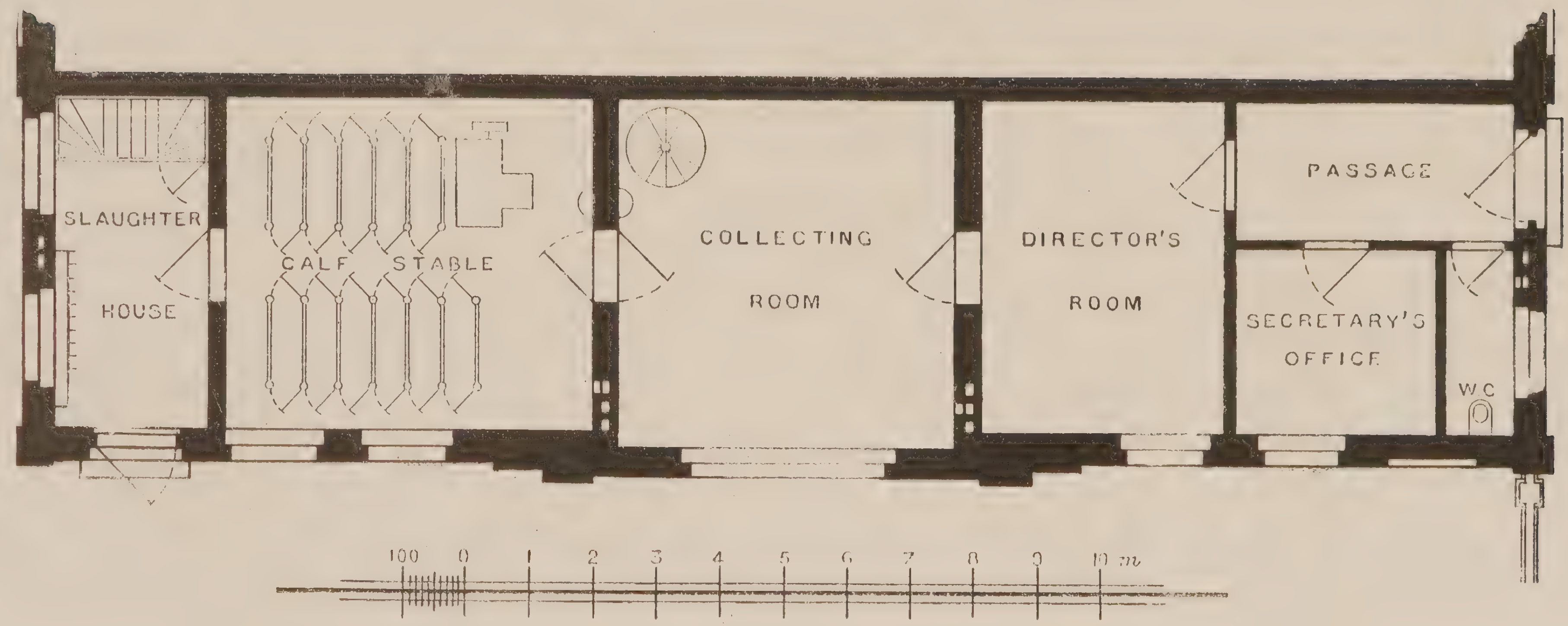
On the ground floor of the building are the corridor, collecting room, calf stable, slaughter room, doctor's room, office, and a closet.

On the first floor, which is reached from the collecting room by a convenient winding staircase, is the laboratory, adjoining which, on both sides, is a large garret. The entrance to the building is from the street, and so arranged that the cattle establishment has not to be traversed in order to enter; the wall belonging to the entrance being continuous with the wall which encloses the cattle establishment. The calves are driven into the station through the doorway of the slaughtering room, which lies at the opposite end of the building.

While the floors of the slaughtering room, calf stable, collecting room, and laboratory are of concrete, the doctor's room and the office have inlaid wooden floors (parquetry); the corridor and closet are laid with "Mettlacher" tiles; and, finally, the rooms in the roof (garrets at the sides of the laboratory) are laid with floor boards. In the slaughtering room, calf stable, and collecting room the floor is slightly sloped in one direction, and at the lowest point there is a drainage outlet which is shut off by a small intercepting trap. The height of the rooms on the ground floor is 3½ metres, except the collecting room, however, which is 4½ metres in height, and that of the laboratory is 3½ metres. All the rooms on the ground floor are vaulted with plain solid arches. The laboratory and garrets have rafters and wooden ceilings. The collecting room, calf stable, and closet are lined, to the height of 1½ metres from the floor, on all four sides, with white opaque glass tiles; the slaughtering room, on three sides (the door side is excluded), to the same height with white glazed tiles. The remaining part of the walls in these rooms is painted with white porcelain enamel. The walls in the doctor's room and the office are papered. In the laboratory and corridor the walls are painted with oil paint. The collecting room is brightly lighted by a window 4 metres wide by 3 metres high. The light entering becomes strongly reflected by the brilliant white walls. The laboratory has three windows, the calf stable two, and the doctor's room and office one large window each. The closet and slaughtering room have each one small window. All the rooms are, therefore, amply lighted.

The calf stable contains 11 stalls for the reception of the calves, *i.e.*, six on one side and five on the other side of the centre passage. The stalls are so constructed that the wall nowhere forms the boundary of a stall, and a clear passage is thus given all round the stalls; they are each 70 centimetres wide and 150 centimetres long. The inclosures are formed of iron lattice work; at the two narrow sides of each there is a

ROYAL LYMPH STATION, COLOGNE.



Ground Plan.

ROYAL LYMPH STATION, COLOGNE.

Elevation.

door permitting the calves to be taken in or out by either side according to convenience. The iron lattice work is painted a light grey colour, so that every speck of dirt can at once be seen and removed. On the floor of the stalls lie wooden gratings. Upon the space which would correspond to the twelfth stall a weigh-bridge is sunk, inclosed with the above-described iron work; this machine allows of the calf being weighed while being taken through. The hollow in which the weigh-bridge stands has also a smell-preventing arrangement. The ventilation of the stable is obtained by a large tube which passes through the garret above. The collecting room has a flap ventilator in the window, as shown on the plan. Between the calf stable and collecting room there is an arrangement of double doors, one of which is thickly padded. The doors, padding, and through-air draught isolate the collecting room both from smell and noise. The closet is a so-called "Unitas" closet. Water is supplied by the city main, and in every room a sink is provided. The lighting is by electricity; in the laboratory, however, the "Auèrches Glühlicht" (a form of incandescent light) has been found preferable.

The heating is effected by means of American stoves; for the doctor's room, however, a gas stove has been provided by reason of its greater suitability. Large gas stoves serve for the heating of the water and milk. For the storage of considerable quantities of lymph a sufficiently large room is reserved in the refrigerating house of the city cattle establishment.

The furniture provided for the Institution is worthy of the handsome rooms and consists throughout of oak. The laboratory is completely fitted for bacteriological investigations, containing all sterilisation apparatus—thermostats, an excellent microtome, microscopes, centrifuge, &c.

The extent of the lymph production may be understood from the following figures:—In the year 1894 about 356,000 portions of lymph were issued, and in this year (1895) the number of portions will nearly reach 400,000.

Geneva.

The Institut Vaccinal Suisse, which was visited by one of us (Dr. Copeman) only, is situated at Lancy, on the outskirts of Geneva. It was founded in 1882 by M. Charles Haccius, the present director of the establishment. Originally a private venture, it is now recognised by the various cantonal governments, M. Haccius, in consideration of an annual subvention, supplying to public vaccinators throughout Switzerland, free of cost, all the lymph required by them in the performance of their duties.

The building in which the Vaccine Institute is housed adjoins a model dairy, also established and carried on by M. Haccius. The Institute building contains two stables for calves, an operating and collecting room, a laboratory, a room in which the packing and distribution of the lymph are carried out, and the director's room.

Stables.—Each of these contains four stalls. The side walls of the reception stable are of concrete; those of the stable adjoining the operating room are of wood. The floors of both stables are of concrete. Calves are received into the first-mentioned stable, and are there kept under observation for four or five days, at the end of which period they are passed into the stable next the operating room. The bedding of the stalls consists of fine wood shavings, this material being, in the opinion

of M. Haccius, decidedly preferable to straw as regards both the cleanliness and comfort of the calves.

Calves.—These range usually from about six to eight weeks old. They are fed on milk, obtained direct from cows in the adjoining dairy, in addition to which they are allowed a certain number of eggs. The calves are purchased from peasants in the surrounding districts. After vaccination and collection of the lymph, they are sold to a butcher in Geneva, at a loss of about 1*l.* on each calf. They are slaughtered in the public abattoir, and the veterinary inspector attached to that establishment furnishes a certificate relating to the healthiness of the calf and the condition of the viscera as ascertained on examination of the carcase.

Vaccination of Calves.—For the purpose of vaccination the calf is strapped down to a tilting table, similar in its main features to those employed in England. The head of the animal is covered with a leathern mask. The whole of the abdomen, the inside of the thighs, and a considerable area of the right side of the body of the animal is shaved, white soft soap and hot water being used in the process. The skin is next washed with a 1 per cent. solution of lysol, and finally with hot boiled water. It is dried with sterilised gauze sponges. The actual vaccination is carried out in a manner similar to that universally employed in the German Government establishments, already described, with the exception that the parallel lines of incision are discontinuous at intervals of about four inches. Occasionally a certain number of incisions are made at a greater distance from each other, and only about a couple of inches in length, in order that the condition of the resulting vesicle may be more readily observed. Any blood which exudes from the incisions is removed with sterilised gauze sponges, and then the skin is put on the stretch, while glycerinated lymph is rubbed into each incision by means of a small and thin ivory spatula. The lymph employed consists of one part of vesicle-pulp incorporated with two parts of undiluted glycerine, and the resulting mixture is stored for about a month prior to use.

Collection and Preparation of Lymph.—After the lapse of four days and a half from the time of vaccination, the calf is again placed on the table and the vaccinated area washed with warm boiled water without the addition of any antiseptic. After drying with sterilised gauze sponges, the vesicle-pulp is removed by scraping with a sharp spoon. The resulting pulp is collected in a glass pot provided with a cover, and when all has been removed the total amount is weighed. Sufficient glycerine (undiluted) is then added to cover the mass of pulp, and the vessel and its contents are set aside for a few days. Subsequently, glycerine and water are added in proportions requisite for attaining the following standard :—

Vesicle pulp - - - - -	1 part.
Glycerine - - - - -	2 parts.
Water - - - - - -	1 part.

and the mixture is then thoroughly triturated in a mixing machine of the kind invented by Dr. Chalybäus of Dresden. The resulting emulsion is employed for human vaccinations, the "seed material" used for the vaccination of calves, having, as already stated, no water added to it.

Occasionally clamp forceps are employed in the collection of lymph, from the smaller vesicles, when it is required to store it along with glycerine, in fine capillary tubes; the resulting material, containing comparatively little epithelial tissue, being therefore more readily drawn up

On the Preparation and Storage of Glycerinated Calf Lymph; by Drs. Thorne Thorne and Copeman.

into the tubes. When collection is carried out in this manner the "crust" is first removed from the vesicle, which is then gently scraped with a lancet. The material thus obtained is mixed with glycerine in the usual fashion.

The emulsion, which is never sent out for use until at least four weeks after collection of the vesicle pulp, is stored prior to distribution in large glass-stoppered tubes. It is sent out in flaçons, plaques, and capillary tubes, according to the amount required in any given case. The flaçons, small glass tubes made of amber-coloured glass and provided with corks, are of sufficient size to contain enough emulsion for 25, 50, and 100 vaccinations respectively. The plaques consist of two small squares of glass, one of which has a shallow excavation on one surface. This is filled with emulsion, then covered with the plain square, and the edges sealed with paraffin. Quantities of emulsion sufficient for five or ten vaccinations are sent out in this way; while fine capillary tubes which are sealed with paraffin are used for sending out lymph for the vaccination of one person only. All flaçons, plaques, and tubes are sterilised before being filled. In order to send them safely through the post they are enclosed in neat metal cases differing in size and shape. These, together with certain printed matter, including a card to be filled up in accordance with the results obtained from use of the contained lymph, are enclosed in a stout glazed orange-coloured envelope secured with a metal clip.

M. Haccius stated that he had, especially of late, experienced some difficulty in getting public vaccinators to fill up and return the cards sent with each consignment of lymph, so that it was not possible to obtain full statistics as to the success attending the use of the lymph sent out from the Institute. On looking over with him, however, a number of cards which had come to hand within the last few months, it appeared that in all cases the success attained was very great; in a not inconsiderable proportion the *insertion* success had reached 100 per cent.

M. Haccius further stated that the structural arrangements of his Institute were the same as when it was first started in 1882, so that they are not in some respects such as would be considered most desirable at the present time. Nevertheless it was impossible not to be impressed with the strict precautions taken to ensure the utmost cleanliness in the case both of the premises and of all persons employed in the various details of the work.

GLYCERINATED CALF VACCINE LYMPH.

PLATE I.

Photograph of tilting table to which the calf is secured for the purpose of vaccination or collection of lymph. The table is in perpendicular position for convenience of strapping the calf to it.

[The Photograph was taken at the Institut Vaccinal, Paris, for MM. Chambon and Ménard.]

PLATE II.

GLYCERINATED CALF VACCINE LYMPH.

PLATE II.

Photograph of tilting table in the horizontal position, with calf secured to it in readiness, whether for operation or for collection of lymph.

[The Photograph was taken at the Institut Vaccinal, Paris, for MM. Chambon and Ménard.]

In other institutions it is usual for the off hind leg of the calf to be raised, and secured to an iron upright. Such elevation of the leg permits of vaccination on the scrotum, mammary region, and of the inside of the thighs.

GLYCERINATED CALF VACCINE LYMPH.

PLATE III.

Photograph showing process of collection of vaccine lymph from the calf; small quantities only being required, as for instance in connexion with the domiciliary visits to small-pox invaded houses in Paris, described in the text.

[Photograph taken at the Institut Vaccinal, Paris, for MM. Chambon and Ménard.]

PLATE III.

PLATE IV.

GLYCERINATED CALF VACCINE LYMPH.

PLATE IV.

Photograph of the van in which vaccinated calves are transported from MM. Chambon and Ménard's Institution in Paris, to streets in which domiciliary vaccinations are to be performed.

GLYCERINATED CALF VACCINE LYMPH.

PLATE V.

Photograph of Trolley employed in the Cologne Vaccine Institution, on which the carcase of a calf, after slaughter, is brought into the "operating room" for the collection of lymph material.

[Photograph taken for M. Vanselow, the Director of the Cologne Institution.]

PLATE V.

PLATE VI.

GLYCERINATED CALF VACCINE LYMPH.

PLATE VI.

Photograph of hot-air steriliser, in which are a number of large test-tubes, plugged with cotton wool and containing capillary tubes, in which glycerinated lymph is about to be stored. After sterilisation the capillary tubes are retained in the apparatus within the plugged test-tubes until required for use.

[Photograph taken at the Institut Vaccinal, Paris, for MM. Chambon and Ménard.]

No. 7.

App. A. No. 7.
Abstract of Medical Inspections.

ABSTRACT of MEDICAL INSPECTIONS made in 1896 with regard to the INCIDENCE of DISEASE on particular places, and to questions concerning LOCAL SANITARY ADMINISTRATION.

1. BICESTER (OXON); population (1891), 3,343; Dr. Theodore Thomson.

Authority concerned: Bicester Urban District Council.

Ground of Inquiry: "Fever" prevalence; Registrar-General's Returns; local complaints.

Chief Facts reported by Inspector: During the period January 1895 to March 1896, 61 persons notified to the District Council as attacked by enteric fever, 12 persons known to have been attacked by illness suspected to have been enteric fever, and 11 deaths referred to enteric fever; the fever occurring mainly in the months of October, November, and December 1895, and being almost entirely restricted to the northern part of the town of Bicester. The conditions of sewerage and drainage, as also the general sanitary circumstances of the town of Bicester unsatisfactory; but the prevalence of the fever not referable to these unhealthy conditions, nor to milk supply, but to the use of water from four wells and springs open to dangerous pollution; the occurrence of this pollution indicated by chemical examinations as regards two of these supplies and by microscopical examination as regards a third; the degree of the pollution probably intensified during wet weather.

2. CHELMSFORD (ESSEX); population (1891); 11,008; Dr. Reece.

Authority concerned: Town Council of Chelmsford.

Ground of Inquiry: Prevalence of diphtheria and enteric fever Registrar-General's Returns.

Chief Facts reported by Inspector: In 1895, 16 cases of enteric fever notified in south ward and one case in north ward, six cases proving fatal. In October and November 45 notified cases of diphtheria, with seven deaths. Scarlet fever, 17 cases, no deaths; 12 deaths from measles. Schools closed.

In 1896, 35 cases of diphtheria notified in first seven months, five deaths. Measles and whooping cough caused several deaths; a few cases of scarlet fever occurred. In April, one case of enteric fever notified, no others till end of June, between which time and third week in August (date of reporting) 27 cases occurred. Insanitary surroundings noted in certain instances.

Water supply inadequate and partly obtained from sources liable to pollution. Distribution of water unsatisfactory. Sewerage system in need of revision, larger sewage farm required. House drainage defective in places. One half of w.c.'s hand-flushed; a few filthy privies. Refuse stored in faulty, large-sized receptacles. Systematic scavenging needed.

Byelaws not strictly enforced, and in need of revision. Very lax enforcement of regulations as to dairies, cowsheds, and

milkshops. Isolation hospital accommodation inadequate. No disinfecting apparatus. Disinfection of houses performed in perfunctory manner. Ambulance provision practically nil.

3. CHICHESTER (SUSSEX); estimated population (1896), 10,808; Dr. Bulstrode.

Authority concerned: Chichester Town Council.

Ground of Inquiry: Prevalence of enteric fever; Registrar-General's Returns.

Chief Facts reported by Inspector: Enteric fever endemic in Chichester for many years, as shown by annual reports of Registrar-General, and by previous reports of Board's Inspectors. Distribution of disease, during period to which this report relates, similar to that observed in former years, before the drainage system or the public water supply now in use had been inaugurated. Evidence that pollution of the soil by defective privies and cesspools had operated as principal cause of the endemicity of enteric fever. No facts in connexion with the 1896 outbreak indicative that the prevalence of enteric fever had been due to the sewerage system, or to the public water supply. Cases during 1896 mild in type, and fatality rate consequently small.

No byelaws in force in district. No efficient disinfecting apparatus. Need for extension of public water service. Sewers leaky in places. Disused privies and cesspools not properly emptied before being filled in, and hence pollution of soil still obtains.

4. FULBECK (NOTTS); estimated population (1896), 500; Dr. Wheaton.

Authority concerned: Claypole Rural District Council.

Ground of Inquiry: Local complaint as to prevalence of diphtheria and insufficiency of preventive measures.

Chief Facts reported by Inspector: An outbreak of diphtheria confined to an outlying collection of eight dwellings. The recognised attacks of diphtheria, 10 in number, confined to three of the dwellings, three of the attacks ending fatally. The appearance of diphtheria preceded, for at least 10 days, by attacks of "sore throat," affecting alike occupants of dwellings in which recognised diphtheria occurred, and of those in which it had not been recognised.

Condition of the eight dwellings most unwholesome; defective drainage, faulty excrement disposal, prevalent nuisances, and unwholesome water supply. Sanitary condition of the village, as a whole, very unsatisfactory.

Action taken by the Rural District Council very inefficient; no isolation hospital provision; no supervision of disinfection of dwellings or clothing; no disinfecting apparatus.

5. GILLINGHAM (KENT); estimated population (1895), 31,683; Dr. Sweeting.

Authority concerned: Gillingham Urban District Council.

Grounds of Inquiry: Prevalence of diphtheria and administrative questions as to school closure; Registrar-General's Returns and report of Medical Officer of Health.

Chief Facts reported by Inspector: Great increase in incidence and mortality from diphtheria early in 1896, sustained into the summer months, almost wholly confined to one ward of the district. Diphtheria seriously prevalent in neighbouring towns of Rochester and Chatham shortly antecedent to its appearance in Gillingham; constant intercommunication between all three places. Medical Officer of Health censured by the school board for having closed a certain school; but this censure afterwards removed. Medical Officer of Health acted irregularly in dealing directly with school board and its officers for the purpose of securing the closure of this school, and in not proceeding in accordance with Article 88 of the Education Code. Unsatisfactory hospital provision; inadequate disinfection.

6. Hatley Cockayne, Village of (Beds); population, 80; Dr. Buchanan.

Authority concerned: Biggleswade Rural District Council.

Ground of Inquiry: Diphtheria; local complaint.

Chief Facts reported by Inspector: A series of cases of diphtheria, 23 in all, between June and September 1896. Of 24 village children below 15 years of age, 17 attacked. Diphtheria believed to be unknown in Hatley before 1896. Type of prevalent diphtheria mild, but paralytic sequelæ in several cases. Two deaths occurred. Diphtheria prevalence attributable to personal infection from child to child, particularly in the case of children who attended the village school.

Hospital of Biggleswade Rural District Council not available for Hatley diphtheria cases; all beds being in use for cases of enteric fever, prevalent elsewhere in the district.

7. Holywell Parish (Flintshire); population (1891), 9,471; Dr. Mivart.

Authorities concerned: Holywell Urban and Rural District Councils.

Ground of Inquiry: Continued prevalence of diphtheria; Registrar-General's Returns.

Chief Facts reported by Inspector: Holywell Urban Parish.—Ten cases of diphtheria with one death, in October-November 1896, among children attending Spring Gardens Schools, or persons associated therewith. Infection probably spread mainly from person to person. A foul well adjoining schools and used by children. No public water supply. No proper system of drainage. Large collections of refuse. Foul middens. No isolation hospital provision or disinfecting apparatus.

Holywell (Rural) Parish.—During 1895 and 1896 down to end of November, 209 cases of diphtheria with 24 deaths. Greatest incidence in August, September, October, and November 1896. Epidemic here an extension of that which occurred in Borough of Flint in 1894 and 1895. Disease spread largely from person to person. Indifference of population

to risk of infection. Locality affected by the diphtheria very damp, and soil saturated with soakage from cesspits and privies. No system of drainage whatever. Cesspits and privies everywhere defective. Water supply insufficient. Dwellings of most miserable kind. No isolation hospital. No disinfecting apparatus. The existing byelaws insufficient, and not enforced.

8. Hucknall Torkard (Notts); population (estimated in 1896), 15,000; Dr. Buchanan.

Authority concerned: Hucknall Torkard Urban District Council.

Ground of Inquiry: Epidemic enteric fever; report of Medical Officer of Health and Registrar-General's Returns.

Chief Facts reported by Inspector: From January 1 to November 15, 1896, 129 cases of enteric fever. Attacks especially abundant in one and another part of Hucknall from June to November, notably in Watnall Road division. Many instances of plurality of cases in sequence in the same house or in neighbouring houses opening to the same common yard. No single infecting agent, such as polluted water, milk, or food identified: local infection of houses or of groups of houses responsible for a large proportion of total attacks. Opportunities of such local infection afforded by prevalent unwholesome conditions.

Population of Hucknall chiefly coal miners and artizans. Considerable recent increase in new houses. Efficient public water supply. Principal sewers old, with considerable defects. Excrement and refuse disposal chiefly in capacious and unwholesome privy middens; recent adoption, particularly for new houses, of pail closets of unsatisfactory construction, without corresponding provision for dry refuse. Scavenging arrangements insufficient and unsatisfactory. Pollution of soil in neighbourhood of dwellings

Sanitary administration of Hucknall lax. Insufficient sanitary staff. Sustained neglect by Authority of important sanitary needs of district. No isolation hospital, in spite of frequency with which its need has been demonstrated in past.

9. Huntingfield (Suffolk); population (1891), 378; and Halesworth; population (1891), 2,316; Dr. Mivart.

Authority concerned: Blything Rural District Council.

Ground of Inquiry: Continued prevalence of diphtheria; local complaints.

Chief Facts reported by Inspector: Huntingfield.—Epidemic prevalence of dipththeria in July 1895. Previously extensive prevalence of "sore throat." Type of epidemic severe. Five deaths out of 19 definitely ascertained cases of diphtheria.

Halesworth.—Epidemic prevalence of diphtheria during 1895 and 1896. During a period of 11 months, 64 recorded cases with eight deaths.

In both parishes disease spread by personal contact.

No hospital or disinfecting apparatus provided by Rural District Council. No public scavenging. No regular system of drainage. Many dilapidated and defective cottage dwellings. Very insufficient and unwholesome water supply. No byelaws adopted.

10. KESSINGLAND (SUFFOLK); population (1891), 1,275; Dr. Bruce Low.

Authority concerned: Mutford and Lothingland Rural District Council.

Ground of Inquiry: Recurring outbreaks of enteric fever; local complaints.

Chief Facts reported by Inspector: Enteric fever in the village during the autumn months in each of three successive years, affecting chiefly one portion of the village. These recurring outbreaks associated with polluted shallow wells and with contaminated soil near dwellings; privy pits and the manuring of gardens with filth have provided the means for excremental fouling of soil and water. Defects in drainage noted. No isolation accommodation provided by the Rural District Council. New public wells properly constructed and protected, and sunk in positions away from houses or gardens, much needed. The introduction of a proper pail system of excrement disposal, with public scavenging, urgently required.

11. LONDON PORT; Dr. Buchanan.

Authority concerned: Port of London Sanitary Authority.

Ground of Inquiry: Suspected bubonic plague; information from Medical Officer of Health.

Chief Facts reported by Inspector: Ss. "A" left Bombay August 21st, called at various ports, reached London September 11th. No illness at all suggestive of plague on board this vessel during the voyage or at date of her arrival in port. A. P., a steward's helper, Portuguese, belonging to vessel, attacked with illness between September 25th and 28th; severely ill 29th; died at Branch Seamen's Hospital, October 3rd. Clinical data consistent with this case having been plague. Plague bacillus found in body after death.

P. M., another steward's helper (Portuguese), on Ss. "A" ascertained to have died from "pneumonia" after some 24 hours' illness, on September 27. Clinical data consistent with this case also having been plague.

Antecedents of the two men. Search for other cases. None found. Source of infection probably some infected article purchased at Bombay, and brought out for the first time on the arrival of ss. "A" in London.

History of a case of doubtful nature on board ss. "B," arriving in London from Calcutta on September 7th.

Preventive measures adopted.

12. LONG BUCKBY (NORTH HANTS); population (1891), 2,267; Dr. Bruce Low.

Authority concerned: Daventry Rural District Council.

Ground of Inquiry: Unsatisfactory nature of the water supply; annual reports of the late Medical Officer of Health.

Chief Facts reported by Inspector: Water supply almost wholly derived from shallow wells sunk in sand and gravel. Wells imperfectly constructed; already polluted, or in constant danger of pollution, owing to their proximity to privy vaults, cesspits, middens, leaking cesspools, defective house drains and street "sewers," pigsties, and wet dungheaps. These

App. A. No. 7.

Abstract of Medical Inspections.

wells repeatedly condemned by the late Medical Officer of Health, who lost his appointment on December 25th, 1895, in consequence of his insisting on the need for a new supply. The opinion of the late Medical Officer of Health amply confirmed by experts—engineering, geological, and medical—as well as by public analysts of repute.

No adequate supply of wholesome water obtainable from the local strata; a scheme for conveying water from an outside source essential.

13. Lowestoft (Suffolk); population (estimated, 1896), 27,162; Dr. Copeman.

Authority concerned: Lowestoft Town Council.

Ground of Inquiry; Prevalence of measles, enteric fever, and diphtheria; Registrar-General's Returns.

Chief Facts reported by Inspector: Measles outbreak presented unusual virulence, 75 deaths having been registered in three months. Serious spread of the disease corresponded with reopening of schools after summer vacation, but decline ensued on excluding children from infected households. Notification of measles now in force.

Enteric fever not referable to any condition newly introduced into the locality. Some 3,000 privy middens in the borough, many of them in proximity to wells. Liquid and other filth of all descriptions stored in these middens leads to gross contamination of the soil. Sewers faulty, ill-ventilated, and fall often inefficient. Outfall sewers broken down and blocked at every high tide.

Nearly all cases of diphtheria occurred in very old houses, deficient in light, air, and ventilation, damp and overcrowded. No evidence as to spread of this disease through school attendance.

Hospital accommodation provided for infectious cases at sanatorium, but extension and improvement of premises required. Slaughter-houses not regulated.

Water supply partly from surface wells, water from which has been condemned on analysis, partly taken by company from lake at Lound. Water of brook running into lake liable to contamination from marshy ground adjoining, heavily manured with human excrement.

14. Ludgvan (Cornwall); population (estimated for 1896), 2,150; Dr. Sweeting.

Authority concerned: Ludgvan Urban District Council.

Ground of Inquiry: Prevalence of diphtheria; Registrar-General's Returns.

Chief Facts reported by Inspector: No marked mortality from diphtheria until 1895, though prior indication of mortality from cognate affections. "Infectious sore throat" prevalent before the appearance of fatal diphtheria in 1894. Eight centres of population affected by the diphtheria. Schools not at first conspicuously operative in propagating the outbreak, but their influence more manifest afterwards under seasonal influences. This subsidiary to personal communication. Water supplies often not easily accessible, and exposed to pollution. No drainage. Unsatisfactory excrement and refuse

disposal. Absence of proper sanitary administration. No reports whatever made by Medical Officer of Health. No death returns sent to him from local registrar. No books kept by nuisance inspector. No compulsory notification. No byelaws. No isolation hospital. No disinfecting apparatus.

15. MANSFIELD [population (1891), 15,925] AND NEIGHBOURHOOD (BOLSOVER, PLEASLEY VALE, WARSOP, &c.) (NOTTS); Dr. Buchanan.

Authorities concerned: Mansfield, Bolsover, Mansfield Wodehouse, and Warsop Urban District Councils.

Ground of Inquiry: Outbreak of illness caused by eating potted meat; report of Medical Officer of Health.

Chief Facts reported by Inspector: Sudden outbreak of illness in Mansfield and neighbourhood, February 12–15, 1896. Chiefly gastro-enteric disturbance, with diarrhœa, vomiting, and colic. Fever in most cases lasting three to four days. Often intense headache, general muscular pains, and irregular nervous symptoms. Illness varying considerably in severity, in majority of cases acute for three or four days followed by slow recovery. In all, attacks of 265 persons heard of. Several severe cases, but no deaths. All sufferers had consumed a "potted meat"—a compound to be distinguished from potted meat in hermetically sealed tins—freshly prepared by a Mansfield butcher, Mr. X. One cwt. of this potted meat made on February 11, and sold from shops in and around Mansfield. Wherever obtained, it caused illness in almost every person who ate it. Incubation period varied from 5 to 36 hours; in majority of cases, however, it was upwards of 12 hours.

Circumstances showed that deleterious agent gained access to the potted meat when it was on Mr. X.'s premises. Manufacture of potted meat described in such detail as obtainable. Inference that illness not caused by any mineral poison. No deleterious agent to be traced in any of known ingredients, and conclusion that this agent (which it is inferred was microbic) reached the compound during or after the manufacture, but before the potted meat left Mr. X.'s premises. Information not sufficient, however, to enable determination of exact way in which potted meat became infected, or of the exact nature of the infecting agent itself. Uncleanliness of certain conditions in the manufacture of potted meat on Mr. X.'s premises described, *e.g.*, slaughtering and dressing pigs in the room used for making sausages, brawn, "potted meat," &c. Micro-organism which caused the mischief assumed to have been harmful, through poisonous products elaborated within the human body after the potted meat had been eaten. Question of incubation considered from this view-point. Explanations suggested for certain other phenomena of the outbreak.

16. MIDDLESBROUGH (NORTH RIDING); population (1891), 75,532; Dr. Bruce Low.

Authority concerned: The Corporation of Middlesbrough.

Ground of Inquiry: Continued prevalence of enteric fever; Registrar-General's Returns.

Chief Facts reported by Inspector: Enteric fever unduly prevalent, more especially during the last three years. In certain years a seasonal increase of the fever, but the disease has tended to persist throughout each year. This endemicity apparently associated with methods of excrement disposal, particularly with the privy-midden system, and with defects in sewerage. The existence of over 3,000 privy middens in the town, in proximity to dwellings, a continual source of pollution of soil and air of the place, and affording favourable conditions for fostering a filth disease like enteric fever. Befoulment of the street surface during the process of emptying the middens constitutes an additional source of danger.

Defects in the sewerage system permit of flooding of houses and streets in certain portions of the town by diluted sewage, under conditions of coincident high tide and heavy rainfall.

Water supply now almost entirely from the Hury Reservoirs, on the uplands beyond Barnard Castle. Pumping from the River Tees at Broken Scar now almost discontinued, and will soon cease altogether. No suspicion of recent diffusion of enteric fever by the public water supply. No evidence found incriminating any milk service.

17. Moggerhanger Village (Beds); population, 350; and Chalton Village (Beds); population, 90; Dr. Buchanan.

Authority concerned: Biggleswade Rural District Council.

Ground of Inquiry: Enteric fever; reports of Medical Officer of Health.

Chief Facts reported by Inspector: Moggerhanger and Chalton built upon "Boulder Clay," overlying Oxford Clay. Water supplies of each village derived from a number of separate wells, usually sunk 15–20 feet into the "Boulder Clay." Wells dry steined, and brickwork frequently faulty. Ground for believing that water reaching each of these wells is commonly derived from the surface drainage of a wide area in the neighbourhood of the well. Several opportunities of contamination of well water from cesspools and privy pits in their vicinity observed. Evidence of chemical analysis that certain wells have been polluted in this way.

18. Penrhynside (Carnarvon); population (estimated, 1896), 500; Dr. Bruce Low.

Authority concerned: Conway Rural District Council.

Ground of Inquiry: Outbreak of fever; complaint by Penrhyn Parish Council.

Chief Facts reported by Inspector: Nature of epidemic illness at first obscure; some cases resembled typhus, others cerebro-spinal fever; and a few influenza. Ultimately malady regarded as true enteric fever; infection imported. At time of outbreak sanitary condition of village bad. Scavenging and the emptying of privies and pail closets unsatisfactory. Some overcrowding in houses. No sewerage. Water supply from extension of Llandudno Water Mains. Pipes encrusted and partially blocked. Service scanty and intermittent, causing villagers to seek temporary supplies from springs and spouts on slopes of

hillside below village. Some of these temporary supplies most probably polluted by washing of surface filth from village down the slopes by heavy rainfall; hence spread of the disease. No evidence of pollution of the public water service. No hospital accommodation provided for isolation of fever cases: extension of infection observed in invaded houses owing to non-isolation. A new public water supply pure and plentiful is now provided from Lake Cowlyd. Public scavenging now undertaken by Rural District Council. A sewerage scheme with outfall to the sea is being carried out. But so far no steps taken to provide isolation hospital accommodation for the Conway Rural District.

19. Portsmouth Borough (county of Hants); population (1891), 159,251; Havant; population (1891), 3,475; Havant Rural District; population (1891), 6,387; Dr. Theodore Thomson.

Authorities concerned: The Town Council of Portsmouth, the Havant Urban and the Havant Rural District Councils.

Ground of Inquiry: Question raised by War Office as to the quality of the water supplied by the Borough of Portsmouth Waterworks Company.

Chief Facts reported by Inspector: The water in question supplied to the Borough of Portsmouth, to large part of the Havant Urban District, to certain villages in the Havant Rural District, and to the Warblington Urban District. The supply derived from three series of springs from the Chalk; one series near the town of Havant, another near the village of Bedhampton in the Havant Rural District, and the third in the Farlington Marshes in the Havant Rural District. Detailed investigation of the surroundings of these springs and of the geological conditions of the neighbourhood; the latter investigation by Mr. Whitaker, F.R.S., of the Geological Survey. The water from the springs near Havant and at Farlington not to be thought of as free from risk of dangerous pollution; the water from the Bedhampton Springs probably free from such risk when certain works in progress at the time of the inquiry have been completed.

20. Sevenoaks (Kent); population (1891), 7,514; Dr. Bruce Low.

Authority concerned: Sevenoaks Urban District Council.

Ground of Inquiry: Complaints from the Committee of the Kent Nursing Institute as to insanitary condition of the urban isolation hospital, in relation with the death of a nurse therein from enteric fever contracted while nursing scarlatina cases.

Chief Facts reported by Inspector: The Sevenoaks urban district isolation hospital, formerly a private house, and which has no facilities for the isolation at one and the same time of two different infectious fevers, was nevertheless in November 1895 improperly used for the treatment of both enteric fever and scarlatina cases. Its sanitary condition in December, owing to neglect of duty on the part of the male caretaker, such as to favour the spread of enteric fever and diarrhœa. The receptacle of the one (earth) closet in the hospital left for days unemptied; and the cesspool close to the house overflowing, dejections of fever patients improperly disposed of. Several nurses were attacked at that time by

diarrhœa and sore throat, and one nurse was seized with enteric fever, from which she died. Administration lax and inefficient, there being no responsible medical superintendent; under pressure of admission of an unusual number of cases, administration broke down. The hospital up to December inadequately equipped; and no means provided for properly disinfecting bedding, clothing, &c. The present Medical Officer of Health recommends the erection of a new hospital on a larger site.

21. Southend (Essex); population (1891), 12,333; Dr. Bruce Low.

Authority concerned: The Town Council of Southend.

Ground of Inquiry: Sustained prevalence of enteric fever and diphtheria; Registrar General's returns, and other sources of information.

Chief Facts reported by Inspector: Enteric fever not absent from Southend for many years. Anomalous cases, which are not usually notified elsewhere, notified here as enteric fever, making Southend appear to suffer more from fever than other places. But recognisable enteric fever undoubtedly endemic. Its persistence associated with pollution of the porous soil, on which the town is built, by human excrement. Sewers defective and outfalls insufficient. No evidence of spread of disease by public water supply or by milk service; but some evidence of certain cases having been due to eating oysters which had been stored on "layings," or kept in boxes, along the foreshore where they were liable to be contaminated by filth from the pier waterclosets and by sewage from the sewer outfalls.

Diphtheria frequently imported by visitors, or brought back by boarders to private schools from London and elsewhere after holidays. Some aggravation of imported infection in poorer class dwellings overcrowded by humbler visitors. Sanitary administration formerly lax, but now greatly improved. A new isolation hospital recently provided. Comprehensive scheme for dealing with sewers and sewer outfalls being carried out. Sanitary staff increased, and its remuneration placed on a more satisfactory basis. Prospect of early removal of conditions that formerly fostered endemic disease.

No. 8.

REPORT on an OUTBREAK of ENTERIC FEVER in the URBAN DISTRICT of BICESTER; by Dr. THEODORE THOMSON.

App. A. No. 8.

On Enteric Fever in Bicester; by Dr. Thomson.

IN the early part of February 1896 the attention of the Board was directed to the fact that the Registrar-General's Returns for the quarter ended December 31st, 1895, indicated that there had been during that quarter seven deaths from "fever" in the Bicester Registration Sub-District, with a population of 7,513. Their attention was also further directed to this fever prevalence by a letter, dated February 18th, and signed by certain householders in the Bicester Urban District, in which it was stated that there had been 57 cases of enteric fever in Bicester since August 11th, 1895, and that fresh cases were still occurring. The persons signing this letter further requested that the Board should make inquiry into this outbreak. No information had been received by the Board from the Medical Officer of Health of the Bicester Urban District as to fever occurrence there. I was accordingly, on March 16th, instructed by the Board to make inquiry into the circumstances attendant on the enteric fever outbreak in question; and, in accordance with these instructions, I visited Bicester on March 27th, and made inquiry in the sense indicated both then and on subsequent occasions.

The outbreak of fever had, I found, been limited to that part of the Bicester Registration Sub-District included in the Bicester Urban District, which, on an area of 3,740 acres, had, at the census of 1891, a population of 3,343 persons occupying 702 houses. The population of the district is nearly stationary, the census of 1891 having shown an excess of only 37 over the enumerated population in 1881. By far the larger part of the inhabitants of the Bicester Urban District reside in the town of Bicester, which has a population of about 3,000 persons.

The town of Bicester, 12 miles from Oxford, is the market town for a considerable agricultural district. It stands upon the clays and calcareous sandstones of the Cornbrash, overlying the argillaceous limestone of the Forest Marble, which crops out on the surface in the immediate neighbourhood of the town. The houses of Bicester are for the most part grouped along two main streets, which diverge from the market place in such fashion that the town may be said roughly to form a V, of which the market place is the apex. The roadways of the main streets are constructed of macadam, with footways of flagstones or of cement, and are fairly good save in so far as they are unprovided with channelling of stone or of other suitable material. The condition of bye-streets, however, frequently leaves much to be desired. A considerable number of dwellings are old; and of these old dwellings not a few are dilapidated and damp, while many are unsatisfactory as regards light and ventilation. Open space in the neighbourhood of inhabited houses is usually sufficient; but in some instances dwellings are closely huddled together and furnished with yards of very scanty dimensions. The surface of some of these yards, which are paved, is broken and uneven; other yards are entirely unpaved. House and yard drainage is for the most part effected by means of 4-inch or 6-inch sanitary pipes, rarely disconnected properly from the sewers to which they discharge. House and yard drains not infrequently pass beneath dwellings; and those portions of the drains are but rarely embedded in concrete. Yard

drains are in not a few instances untrapped, or are fitted with traps of inefficient sort. Indoor sinks are unusual in houses of the poorer class, but are, where they exist, usually disconnected from the drains to which they discharge. Excreta are disposed of mostly in vault privies or in pail closets; there are only a few waterclosets, usually of the long-hopper pattern and devoid of flushing apparatus. House refuse is stored in pails and tubs, and is, along with the contents of pail closets, removed twice a week by the District Council. Removal of the contents of vault privies devolves upon the owners or occupiers of the houses to which they are attached, and these receptacles are seldom cleansed oftener than once a year. The sewerage system of the town is formed for the most part by 9-inch and 12-inch sanitary pipes converging to an 18-inch brick barrel sewer, by which the sewage is conveyed to outfall works. These works are about a mile south of the town, and consist of six settling tanks, from which the sewage is distributed by carriers over pasture land in the vicinity. The effluent sewage from this land finds its way into a neighbouring brook. The majority of the sewers in Bicester are said to have been laid down some 35 years ago, but there are one or two short lengths of sewer of more recent construction. There is reason to believe that some sewers are in a defective condition. Provision for ventilation of sewers is either inadequate or entirely absent. Save in the case of two short lengths of sewer of more recent construction, sewers are entirely devoid of manholes or lamp-holes. Flushing of sewers, when attempted, is sought to be effected by emptying the contents of water carts down street gulleys. The water supply of Bicester is furnished in the main by shallow wells, usually dry-steined, sunk in the rubbly rock on which the town stands; partly by two springs at the northern end of the town, known as the Crockwell spring and the Brockless spring respectively, and by the Bicester brook, which flows through the town, and from which a few households take their domestic water supply.

The history of Bicester as regards prevalence of enteric fever in the past cannot be regarded as satisfactory. During the 10 years, 1885–1894, 8 deaths were referred to enteric fever in the urban district, affording a mean annual death-rate from this cause of 0·24 per thousand during the period quoted. In four only out of those 10 years was no death referred to this cause in Bicester. During this same period the mean death-rate from enteric fever per 1,000 persons living in England and Wales was 0·18. Notification of enteric fever, among other diseases, became compulsory in the Bicester Urban District in 1890; and during the five years 1890–94, 66 cases of this disease were notified to the Sanitary Authority as having occurred in this district. Fifty-six of these were notified in 1890 alone; and to this occurrence of fever reference will again be made at a later stage of this report.

The time of commencement and the subsequent course of the more recent outbreak of enteric fever which forms the subject of this report will be gathered from the appended table, which shows, month by month, from January 1895 to March 1896, the number of cases of enteric fever notified to the Bicester Urban District Council as having occurred in their district during this period. The table also gives the number of deaths referred to this cause during the same period, and, in addition, takes note of a few cases of sickness which, though not notified to the District Council by the medical attendants, were by these latter, nevertheless, regarded as bearing a suspicious resemblance to enteric fever.

App. A. No. 8.

On Enteric Fever in Bicester; by Dr. Thomson.

TABLE showing, Month by Month, during 1895, and the First Quarter of 1896, the NUMBER of PERSONS reported to the BICESTER URBAN DISTRICT COUNCIL as attacked by ENTERIC FEVER in their District; also the NUMBER of PERSONS known to have suffered from Disease suspected to have been Enteric Fever, and the NUMBER of DEATHS referred to Enteric Fever in this District during the same Period.

Period.	Number of Persons notified as attacked by Enteric Fever.	Number of Persons attacked by Disease suspected to have been Enteric Fever.	Number of Deaths referred to Enteric Fever.
January 1895 - -	—	—	—
February ,, - -	—	—	—
March ,, - -	—	—	—
April ,, - -	—	—	—
May ,, - -	1	—	—
June ,, - -	—	—	1
July ,, - -	1	—	—
August ,, - -	1	—	—
September ,, - -	—	5	—
October ,, - -	20	3	—
November ,, - -	13	3	6
December ,, - -	14	—	1
January 1896 - -	5	—	2
February ,, - -	4	—	1
March ,, - -	2	1	—
January 1895 to March 1896 -	61	12	11

It will be observed from the above figures that within the period embraced by the table 61 cases of enteric fever were reported as having occurred in the district, while 11 deaths were referred to this cause; and that 12 persons are known to have suffered from illness which, although not reported to the District Council as enteric fever, was in each instance regarded as having been suspiciously like that disease. During the above-mentioned period only three cases of enteric fever were reported before October 1895, in which month the reported cases suddenly rose to 20; remaining numerous during November and December, and decreasing during January February, and March of 1896. The "suspicious" cases were mostly noticed just before or during the early stages of the outbreak of diagnosed enteric fever. With one exception these suspicious cases occurred in houses that already had been, or that were subsequently notified as, invaded by enteric fever. Altogether 30 houses were reported as invaded by enteric fever during and subsequent to the month of October; these 30 houses having a population of 194 persons, of whom 58 were reported as attacked by enteric fever. It will be seen, therefore, that nearly a third of the persons living in these houses were notified as attacked by enteric fever in the course of this outbreak.

In the 12 months, April 1895 to March 1896, the mortality caused by enteric fever in the Bicester Urban District was 3·3 per thousand persons living; and the fatality of the disease during the same period was, if suspicious cases be not reckoned as enteric fever, 18 per cent. of

App. A. No. 8.

On Enteric Fever in Bicester; by Dr. Thomson.

persons attacked. The outbreak, therefore, was, in regard of the small population involved, a serious one.

This outbreak of enteric fever did not extend over the whole of Bicester; it was, in fact, almost entirely restricted to the northern part of the town, as may be seen by reference to the appended map. With five exceptions all the invaded houses lay tolerably near together towards the extremity of one of the limbs of the V which the town of Bicester forms; and, indeed, of these five exceptions three were houses which, although not situated within the area of chief invasion, were nevertheless at no great distance therefrom. Accordingly, in search for the cause of the outbreak, only possible fever-agencies restricted in their operation to the quarter of the town mainly affected by the disease could be accepted as satisfactorily accounting for its occurrence. In this respect possible causes of fever such as sewerage conditions, general sanitary circumstances, and milk supply were alike found to fail.

As regards sewerage conditions, there did not appear reason to regard them as more faulty in the area chiefly invaded by fever than in other parts of Bicester entirely free from the disease; indeed, the sewers in St. John Street and Field Street, in both of which streets several houses were invaded by the fever, are among the few sewers in Bicester in which attempt at ventilation has been made. Further, the houses in the main area of invasion drain to two sewers passing, as shown on the map, in different directions, and having no connection the one with the other until they reach the main sewer in Chapel Street, a considerable distance from the area in question.

The general sanitary circumstances of invaded houses were, for the most part, unsatisfactory in one or another respect. Defective drainage arrangements were found in not a few; in some, excreta were disposed of in offensive vault privies; while the houses themselves were not always satisfactory as regards proper access of light and air and freedom from conditions of dilapidation and dampness. Amongst this variety of defective circumstances there were, however, none that could be regarded as accounting for the distribution of the fever; indeed, the previously noted localisation of the disease was far from being accompanied by a corresponding limitation of these unhealthy conditions to the part of Bicester in question.

Inquiry as regards milk supply of the 30 invaded houses elicited the information that these had been supplied by one or other of four different vendors. The following list shows the number of invaded houses supplied by each of these four persons, and also the total number of houses ordinarily supplied by them:—

A	supplied	21	invaded houses;	total	houses	supplied in	Bicester daily	about 180
B	,,	9	,, ;	,,	,,	,,	,,	80
C	,,	7	,, ;	,,	,,	,,	,,	130
D	,,	2	,, ;	,,	,,	,,	,,	10

It will be observed that the total number of invaded houses supplied by A, B, C, and D is in excess of 30, this being due to some of these houses taking milk from more than one of these vendors. There was a relatively larger incidence of fever on the customers of A and B than on those of C, which may be referred to the fact, ascertained by inquiries made in the chief area of invasion, that A and B supply a relatively greater number of families in the northern or chiefly invaded end of the town. Furthermore, the fact that the disease was almost entirely limited to this end of the town, while all these milk vendors

App. A. No. 8.

On Enteric Fever in Bicester; by Dr. Thomson.

supply other parts of Bicester, is in itself sufficient to exclude milk from suspicion of having been the vehicle by which the fever was disseminated.

When, however, inquiry was made concerning conditions of water supply, a series of facts came to light which were found to be consistent with water having been the agent whereby, in this instance, enteric fever had been spread. Comprehension of these facts will be facilitated by the following list, which shows week by week, during the period of chief prevalence of the fever, the number of cases notified as enteric fever and also of those suspected to have been enteric fever :—

—	Number of Cases notified as Enteric Fever.	Number of Cases suspected to have been Enteric Fever.
During the week ending September 21st -	—	2
,, ,, ,, 28th - -	—	3
,, ,, October 5th -	—	1
,, ,, ,, 12th - -	—	1
,, ,, ,, 19th -	—	—
,, ,, ,, 26th - -	10	—
,, ,, November 2nd -	12	1
,, ,, ,, 9th -	5	3
,, ,, ,, 16th - -	1	—
,, ,, ,, 23rd -	—	—
,, ,, ,, 30th -	5	—
,, ,, December 7th - -	5	—
,, ,, ,, 14th -	—	—
,, ,, ,, 21st - -	7	—
,, ,, ,, 28th -	2	—
,, ,, January 4th - -	2	—
September 18th to January 4th -	49	11

The first group of cases notified as enteric fever occurred, it will be seen, in the four weeks October 20th–November 16th, and comprised in all 28 persons. Of these 28 persons no fewer than 26 derived their water supply from a spring known as the "Crockwell spring," shown on the accompanying map. The houses occupied by these 26 persons were all situated in the vicinity of the Crockwell spring with three exceptions, viz., Bicester House, a house in Rogues Row at the extreme north of the town, and the more easterly of the two invaded houses lying between Sheep Street and Love Alley. All these three houses are provided with wells of their own; but, Crockwell spring having a considerable local reputation, the occupiers of Bicester House and of the house in Rogues Row were in the habit of using the Crockwell spring water in preference to that of their own wells.* The third of these three houses, namely, the more easterly of the two invaded houses lying between Sheep Street and Love Alley, was occupied at night by two members of the family inhabiting the invaded house in Rogues Row. Those two persons slept in the Sheep Street house owing to insufficiency of accommodation at home; but they took their meals at home, and, as a consequence, drank of the Crockwell spring water.

* It is noteworthy that this particular house in Rogues Row was the only one in that street known to have been supplied from the Crockwell spring, and was also the only house in that street known to have been invaded by enteric fever.

App. A. No. 8.

On Enteric Fever in Bicester; by Dr. Thomson.

I have noted that 26 of the 28 persons constituting the first group of attacks derived their water supply from the Crockwell spring. Of the two remaining persons one resided in the chief area of invasion. This was a boy nine years of age, residing in a house in Plough Terrace, on the west side of New Buildings, supplied with water from a well common to all the houses in that terrace. The other was a girl residing in the more westerly of the two houses lying between Sheep Street and Love Alley. The house occupied by this girl was in the same yard as that used at night by the two members of the family from Rogues Row already referred to. These two persons belonging to Rogues Row were both notified as attacked by the fever on October 24th, while the girl was notified as attacked on November 7th, a fortnight later. All three used the same privy.

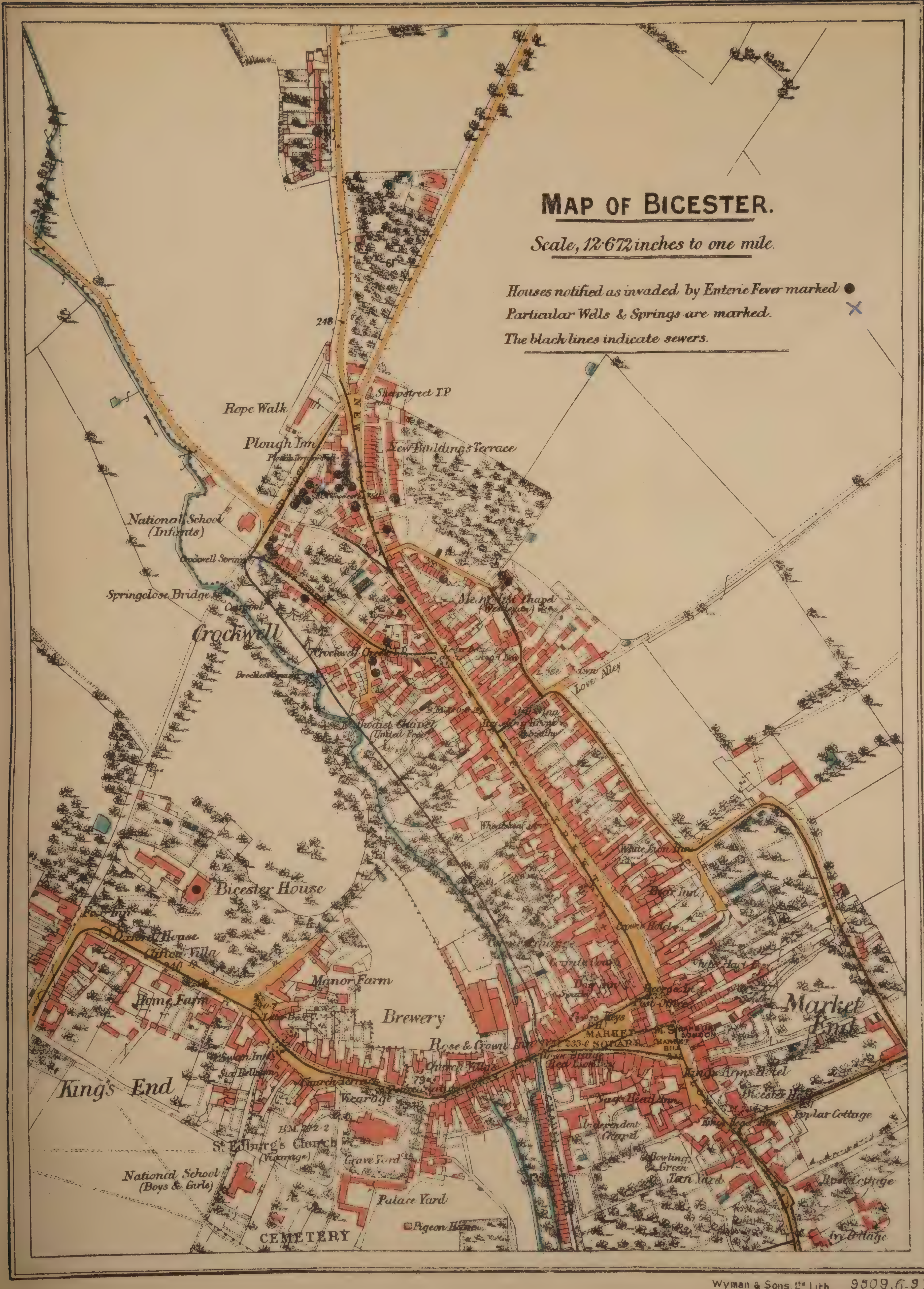
As regards the 11 cases in the second column, considered to bear suspicious resemblance to enteric fever and all attacked prior to November 10th, it appeared, on inquiry, that eight resided in houses which derived their water supply from the Crockwell spring; and three in houses in Plough Terrace supplied from the well common to the houses in that terrace.

The Crockwell spring, it may here be noted, was closed on October 25th, nearly three weeks before the date of notification of the last case of what has been termed the first group of attacks. The disuse of this spring on this date is not, in view of the facts I have given, inconsistent with the water therefrom having acted as the vehicle of infection during the period covered by the first group of cases, if two weeks be allowed for incubation of the disease and one week for sufficient development of symptoms to permit diagnosis. The Plough Terrace Well, however, remained in use.

After November 16th a week elapsed without any further notification of fever occurrences to the District Council. But during the fortnight November 24th–December 7th, 10 notifications of persons attacked by enteric fever were received; and of these 10 persons 7 resided in houses supplied from the Plough Terrace Well, while 3 derived their supply from other local wells. Of these 3 persons one resided in the house in Rogues Row before noted as invaded. This person was notified as suffering from enteric fever on November 24th; the last case that had previously occurred in that house having been notified on October 28th, and having been removed to hospital on the same day. The inhabitants of this house had, on the closure of Crockwell spring, reverted to the use of their own well, which was dry-steined and within 15 feet of the vault privy used by the household. Another of these 3 persons was a boy, aged six, residing in New Buildings, within the chief area of invasion, in a house furnished with water from a well in the yard. The third was an occupant of the remaining one of the five houses formerly noted as lying outside the chief area of invasion, and was a medical man who had been in attendance on the sick both at their homes and at the hospital for infectious diseases, to which many were removed.

The well, referred to as Plough Terrace well, was closed on December 2nd.

After the date of notification of the last case of the second group, a week elapsed during which no further cases of fever were notified. But between December 15th and January 4th, 11 more cases were notified as attacked by enteric fever. Of these 11 cases, 7 resided in houses deriving their water supply from a well known as Mrs. Woodcock's well (*see* map), one in a house supplied by Plough Terrace well, and 3 in houses with other supplies. Of the 3 last-mentioned cases one



Wyman & Sons, Ltd, Lith, 9509.6.97

was a boy of 12, notified on December 15th, residing in New Buildings, in a house where 2 previous cases had occurred, notified on October 23rd and November 2nd respectively, and which had been treated at home. Another was a girl of 18, notified on December 17th, residing in a house to the east of New Buildings in which a case, notified on November 16th, and a suspicious case first attended by a medical man on September 26th, had previously occurred. The third was a second case in the house lying to the west of Sheep Street, outside the area of chief invasion. This case was notified 13 days later than the first already referred to as having occurred in this house; but, on inquiry, it appeared that only nine days had intervened between the dates of *attack* of these two cases.

Mrs. Woodcock's well was closed on January 3rd, 1896.

From January 4th to the end of March, 9 cases of enteric fever were notified in Bicester, and one case regarded as bearing suspicious resemblance to that disease is known to have occurred. Of the 9 notified cases 2—notified on January 13th and 17th respectively—occurred in houses supplied with water from Mrs. Woodcock's well, and 5—of which the first was notified on January 28th—in houses supplied with water from a spring known as the "Brockless spring." Of the remaining 2 one was of a female who had, for some weeks prior to her falling ill, been attending a person suffering from enteric fever; the other was of a resident in New Buildings, occupying a house in which two previous cases had occurred some three months before, and which was supplied with water from a well known as Mrs. Smith's well. The person attacked by illness regarded as resembling enteric fever fell ill about the middle of March. In this patient's house there had already been two cases of enteric fever, notified on October 24th and 31st respectively, and treated at home. Subsequent to the closure of the Crockwell spring the occupants of this house had derived their water supply from Mrs. Smith's well.

It appears from the foregoing account that the fever cases occurred in four successive groups; that persons in the first group used mainly Crockwell spring water; persons in the second group mainly Plough Terrace well water; persons in the third group mainly water from Mrs. Woodcock's well; and persons in the fourth group mainly water from the Brockless spring. These facts suggested that the specific contagium of enteric fever had gained access to each of these several springs and wells, and had thus obtained entrance to the bodies of persons making use of water therefrom. Inquiry was accordingly made as to whether the circumstances and surroundings of these sources of water supply had been such as to allow their becoming dangerously polluted.

The *Crockwell Spring*, which was the main source of supply of the first group of persons attacked, is situated, as shown on the map, on the western boundary of the chief area of invasion of the fever, lying at the junction of Field Street and St. John Street. It is completely covered in; its water rising into the lower extremity of a 30-inch vertical stoneware pipe some 8 feet in length, over the upper end of which is laid a flagstone at the ground level. Water is obtained from it by means of a pump. As will be seen from the map, the sewers in Field Street and St. John Street converge to the neighbourhood of this spring, near which they join, and the joint sewer thus formed passes close to the spring. On the occurrence of the outbreak of fever in October 1895 the greater portion of the Field Street sewer and part of the St. John Street sewer near the spring were exposed, and both of these sewers were then found to be leaking freely into the surrounding soil at several points. The

App. A. No. 8.
On Enteric Fever in Bicester; by Dr. Thomson.

point at which these two sewers join is at a distance of 8 feet from the Crockwell spring, and it was found that this junction had been made by knocking a hole in one of the pipes forming the Field Street sewer and applying to this hole the extremity of one of the pipes forming the St. John Street sewer, while over the partial gap thus left a piece of stone was cemented.* Also it was found that at this point of junction free leakage was going on into the surrounding soil, which is stated to have been quite black. During one of my visits to Bicester, in April 1896, I had this junction again exposed, and found that these conditions remained unaltered. At this date the Field Street sewer close to this point of junction was half full of black silt.

The Well in Plough Terrace Yard, which mainly formed the water supply of the second group of cases, is stated to be a shallow dry-steined well. Within 4 feet of it was a urinal (now abolished) attached to a public-house. The floor of this urinal was paved with brick, but I was informed that it had been usual for the adjacent wall and unpaved yard soil to be used for urinal purposes. The drain of the urinal was within 6 feet of the Plough Terrace well, while the drain of the public-house yard was within about 15 feet of this well. Reference to the map will show that the Plough Terrace well lies within and towards the apex of a triangle formed by the Field Street and the New Buildings sewers, from neither of which is it far distant.

Mrs. Woodcock's Well, which mainly supplied the third group of persons attacked, is situated, as shown on the map, behind one of the houses abutting on Field Street. It is shallow and dry-steined, and when attention was directed to it by the occurrence of fever among persons drinking this water it was found that the yard drain, which passed within a few inches of the well, was leaking freely, and its contents visibly percolating into the well. This yard drain received water-closet sewage as well as sink and yard drainage.

The Brockless Spring, which mainly supplied the fourth group of cases, is an open spring situated to the west of the chief area of invasion, and on the bank of the Bicester Brook. It is surrounded on three sides by gardens which are under cultivation and freely manured, and a vault privy is situated about 45 feet from it. Within some 30 feet of it passes the sewer previously alluded to as formed by the junction of the Field Street and St. John Street sewers. The condition of this sewer in the neighbourhood of the spring is unknown; but that part of the sewer which lies in the adjacent field where a cesspool is shown on the map was found, when uncovered seven years ago, to contain much silt and to be leaking at many points. The Brockless spring is about 6½ feet below the ground level, and the sewer, at the point where it passes the spring, is said to be about 5 feet below the ground.

It will be seen, therefore, that in the neighbourhood of each of these four springs and wells there were abundant conditions threatening dangerous pollution of the waters in question, and the pervious nature of the soil in which these wells are sunk, and though which these springs come to the surface, would interpose but little obstacle to the access of polluting matter to them. Samples of water for chemical and microscopic examination were taken from each of these sources of water supply as follows :—

From the Crockwell spring on October 31st, 1895.
,, ,, Plough Terrace well on November 27th, 1895.
,, Mrs. Woodcock's well on December 27th, 1895.
,, the Brockless spring on February 22nd, 1896.

* Both these sewers are constructed of 9-inch sanitary pipes.

Chemical analysis of the sample taken from the Crockwell spring failed to detect anything indicating dangerous pollution of the water; but "a large number of bacteria, whose nature could not be determined "by direct microscopic examination," were discovered in the sample, and this in such amount "as to cast great suspicion on the character of the water." Chemical examination of the samples of the water from the Plough Terrace well, and from Mrs. Woodcock's well gave unfavourable results in both instances. In the former, the chlorine present amounted to 14·45 grs. per gallon, and in the latter it was 6·60 grs. per gallon: while in both waters the quantity of albuminoid ammonia was far in excess of that usually associated with pure water. Chemical examination of the sample from the Brockless spring failed to detect anything indicating dangerous pollution of the water.

In view of the foregoing facts I made inquiry as to possible relation between amount of rainfall and outbreak of fever. I was unable to obtain exact meteorological data; but, by the courtesy of Captain Fane, of Bicester House, I was furnished with a record of local rainfall, kept by him in such terms as "showers," "rain," and "wet," according to the amount estimated by him to have fallen. From his record it appears that, during the whole month of September 1895, no rain fell in Bicester, save a few "showers" on the 3rd and the 10th* of that month; and that this lengthy period of drought was broken by "wet" weather on the 3rd, 4th, 5th, and 6th of October, closely followed by "rain" on the 8th, 9th, and 10th of the same month.

The first notifications of the outbreak of fever were dated October 22nd, while in the two weeks ending respectively October 26th and November 2nd, no fewer than 22 cases were notified. If two weeks be allowed for incubation of the disease, and about a week for development of symptoms sufficient to permit diagnosis, it will be seen that this rainfall in early October took place about the time when these persons most probably contracted the disease. Owing to there having been a good deal of rain on numerous occasions in November, like relationship between rainfall and further outbreaks of fever is not so definitely suggested; but it is noteworthy that the notifications of the second group of cases date from November 24th, and that there was wet weather on November 3rd, 4th, 5th, 7th, 8th, and 9th. As regards the third group of cases, also, it may be observed that while the notifications ranged mostly about the 15th and 20th December, there had been wet weather on the 27th and 28th of November. These facts are consistent with foul matters accumulated in the half-choked and leaky sewers of the northern end of Bicester, and polluting material in the surrounding soil, having been periodically washed by falls of rain into neighbouring wells and springs.

It appears, then, that of accepted agencies in spread of enteric fever, only one, and that one water, was found parallel in its circumstances with dissemination of fever in Bicester; and, moreover, that the four water supplies mainly used by the persons attacked were all of them open to dangerous pollution. That pollution in this sense had actually occurred was indicated by chemical examination as regards two of these waters, and by microscopical examination as regards a third; while the data given in connection with rainfall tend to suggestion that the degree of this pollution was intensified periodically during wet weather, when foul matters would be likely to be washed into the springs and wells.

* Possibly connected with the occurrence of "suspicious cases" from September 20th to October 4th.

App. A. No. 8.
On Enteric Fever in Bicester; by Dr. Thomson.

Careful inquiry was made as to whether there had been in Bicester anterior to the October outbreak any case or cases of enteric fever to which that outbreak might be referable. Three persons are known to have been attacked by enteric fever in the district prior to October, viz., one in May, one in July, and one in August. The cases that occurred in May and August were not within what has been in this report termed the chief area of invasion; the July case was within this area. The last-mentioned case occurred in New Buildings, and was notified on July 25th. But nothing was discovered tending to connect this case or either of the two other cases with the subsequent outbreak. As regards possible pollution of the Crockwell spring, however, by the particulate contagium of enteric fever, it is worthy of note that several common lodging-houses, largely used by tramps, drain into the St. John Street sewer, and that, as before stated, this sewer was found to be in a defective state near the Crockwell spring. No occupant of any of these lodging-houses, so far as could be ascertained, suffered from illness of a suspicious sort during July, August, September, or October 1895.

It is of interest in connection with the epidemic prevalence of enteric fever in Bicester to which this report has reference, to recall the fact that, in the latter part of 1890, 56 cases of the same disease are known to have occurred in the district, and that then also, as in the recent outbreak, the fever was mainly prevalent in the northern end of the town. Mr. Dyson Wood, then as now Medical Officer of Health for the Bicester Urban District, gave it as his opinion, in a report written by him in September 1890, that the outbreak that occurred in that year was principally due to impure water, and he stated that the Crockwell spring, which formed the water supply of many of the persons attacked, was found to have "some yards of defectively jointed drain pipes in its "immediate neighbourhood."

Action taken by the District Council.

All houses known or suspected to be invaded by enteric fever are stated to have have been immediately visited by an officer of the District Council, by whom instruction was given as to the measures of isolation proper to be taken. In many cases where accommodation for isolation at home appeared insufficient, the person attacked was removed to the hospital for infectious diseases jointly provided by the Bicester Urban and Bicester Rural District Councils. In the course of the outbreak 36 persons suffering from enteric fever were removed to this hospital. After removal of the patient to hospital, or subsequent to his recovery if treated at home, measures of disinfection were applied to the invaded house. These measures usually consisted of fumigation of the rooms regarded as infected for not less than six hours by sulphurous acid or by vapourised carbolic acid; steeping of infected articles of clothing and bedding, other than mattresses, for 12 hours in a solution of carbolic acid and water of the strength of 1 in 40, and subsequent washing of these articles with carbolic soap and water; exposure of infected mattresses and carpets, after sharing the fumigation of rooms as above, in the open air for as long a period as possible; washing of floors and woodwork of infected apartments with carbolic soap and water, brushing ceilings and walls with a house brush, and, in some instances, whitewashing of ceilings. The sanitary condition of invaded premises was examined, and measures were taken towards correcting sanitary defects discovered. In this way 19 vault privies were abolished and replaced by pail closets; in several instances house drains were

App. A. No. 8. On Enteric Fever in Bicester; by Dr. Thomson.

taken up and relaid, while in other instances minor improvements in drainage and other conditions were brought about. The Field Street sewer was in a large part relaid. The St. John Street sewer, however, although exposed in part of its length, was not repaired, and the defective manner in which junction had been made between the St. John Street and Field Street sewers was allowed to continue. The sewers and several drains in the chief area of invasion were flushed twice a week from December 7th to the end of February, and after February once a week, with a solution of carbolic acid of the strength of 1 in 40. In this way about 10 gallons of carbolic acid were employed each week during the first of these two periods. Inhabitants of houses invaded by fever, as well as of some houses that had not been invaded, were cautioned not to use unboiled water or milk. Samples of water were taken from several springs and wells and submitted to chemical and microscopic examination, and four wells and springs were closed at different dates. Three of these, with the dates of their closure, have already been referred to: a fourth well in New Buildings was closed on December 12th, 1895.

From the foregoing account of enteric fever in Bicester in 1895 and the early part of 1896, and of the circumstances attendant upon it, it is evident that there are many conditions of unhealthy sort in this district. The most prominent of these is water supply; and the District Council should, without further delay, furnish the inhabitants of Bicester with a sufficient supply of water of undoubted purity. The Authority have not been without previous warning as to the need for such action. In 1890 Mr. Dyson Wood, Medical Officer of Health to the District, wrote, in his report on the outbreak of enteric fever in Bicester, as follows :—"In the first place, a safe water supply for the "district is essential. I am inclined to think that no insuperable "difficulty need be anticipated under this head." This constituted one of three recommendations made by Mr. Dyson Wood in that report; and in reference thereto it was unanimously resolved at a meeting of the Sanitary Authority on September 1st, 1890, "That immediate "measures be taken to carry out the recommendations, in all par- "ticulars, contained in the report." Further report on this subject was made in connection with the recent enteric fever in Bicester by Mr. Dyson Wood, on January 6th of the present year, to the following effect :—"Having regard to recent unfavourable analyses of drinking "water which have come under my notice, and to the knowledge "which I possess of the unsafe position of numerous other well waters "in the town, I am quite of opinion that it is necessary for the future "safety of Bicester that your Council should, with as little delay as "possible, take up practically the question of supplying the town with "a wholesome water supply from an outside source." It may here be noted that the Urban District Council had already, on November 11th, 1895, resolved that "An engineer be engaged to make a survey, and "estimate cost of waterworks for the town in view of the possibility of "the same being found necessary for the future." The water supply of the town was again under discussion at the Council's meeting on January 6th, 1896. When I visited Bicester, in March and April of the present year, this subject had not yet passed the stage of discussions and resolutions; the fever meanwhile continuing to occur in the district. Before leaving Bicester, I met and conferred with the Chairman of the Urban District Council on April 10th, and at that conference I laid especial stress on the need for immediate steps being taken by the Council to provide a sufficient supply of pure water for the

inhabitants of Bicester. The Chairman undertook to bring the matter under the notice of the Council at their next meeting.

As I have indicated, the most pressing need of Bicester is a pure water supply. The District Council, however, should also give attention to measures remedial of other unhealthy conditions described in this report. Defects as regards structure, ventilation, and flushing of sewers, as well as defective conditions of house and yard drainage should be sought out and remedied when discovered. The methods of disposal of excreta in Bicester leave mnch to be desired, and improvement of these should have the attention of the Council. Much house property in the town is old and dilapidated, and measures should be taken to secure the closure or sufficient improvement of such dwellings. The need for a sufficiency of open space around inhabited houses and for suitable paving of yards attached to them should also receive attention.

No. 9.

REPORT upon PREVALENCE of ENTERIC FEVER in the City of CHICHESTER; by Dr. H. TIMBRELL BULSTRODE.

A representation having been made by the Mayor of Chichester (Mr. E. Prior), and by Mr. Davy, the Board's General Inspector of the district, that enteric fever was prevailing in Chichester, I was instructed, on July 14th, 1896, to confer with Mr. Davy upon the subject, and the same evening I left London for this purpose. On the following morning we together visited Chichester, and, by arrangement, conferred with the Mayor and borough officials, as also with several members of the Sanitary Committee, and with the Chairman of the Water Company. At this conference I received valuable information in a list of fever cases which had been drawn up by the Mayor, and which showed the condition of each house, with the source of water supply in each instance. In this way, and by the assistance which was afforded me by others present, several of whom were medical men, I was enabled to form a general idea of the relative importance of the several agencies of fever that might possibly have been in operation; and after inspecting certain of the invaded houses, as also the public waterworks, I was in a position to make certain verbal recommendations, with a view of limiting the prevalence of the disease. Subsequently, after receiving some additional information which I had requested to be furnished me, I re-visited Chichester, and left with the town clerk certain formal recommendations, reproduced in the Addendum to this report. A resolution was in due course passed at a meeting of the Sanitary Committee to carry out these recommendations in their entirety.

Later, I made detailed investigation into the prevalence of enteric fever in Chichester, upon which I now report.

The city of Chichester is situated on an extensive plateau extending, between the South Downs and the coast, from Portsmouth to Brighton. Its position is, for the most part, a low-lying one, but towards the north the ground surface rises gently in the direction of the Downs of Goodwood. The greater portion of the city is built upon gravel soil, overlying the London clay, but parts of it are situated apparently on the Woolwich and Reading Beds. The gravel overlying the deeper formation is coarse in character, and its thickness appears to vary from 7 to 30 feet, or more. The older parts of the town are surrounded by the city walls, some 1½ miles in circumference, there being inside the walls about 682 houses.

The population of Chichester *Urban Sanitary District*, as enumerated at the last census in 1891, amounted to 7,830, while in 1881 the population was 8,149. The population of the registration district—which, during the periods referred to, was not exactly coterminous with the sanitary area—was, in 1891, 7,887; and in 1881, 8,569. Since 1891 the area of the registration district has been extended, and that of the sanitary district has been made coterminous with it; so that Chichester now possesses an estimated population of 10,808. The number of houses in the extended district is estimated at 2,722.

The chief industries of the district are those connected with agriculture, brewing, and tanning. The city is the market town of the surrounding districts; a cattle market, the largest in the south of England, is held here fortnightly, and the cathedral attracts numerous visitors.

App. A. No. 9.

On Enteric Fever in Chichester; by Dr. Bulstrode.

The main streets of the city, which are wide and well-constructed, run directly north, south, east, and west, and in the centre of the city stands the old market cross. The town is traversed by the Lavant, and by branches of this river, some of them artificial. In winter the river and its branches give passage to a good deal of upland water, but in summer all these channels tend to become dry or to contain more or less elongated pools of stagnant water.

Entering the town at the north-east, the Lavant runs along the north of Westhampnett Road until near Bootle Lane, there passes beneath that road, and continues its course at the back of the houses and gardens of St. Pancras towards Eastgate. Near Stane Street, St. Pancras, the channel is culverted for a short distance, and again on nearing Eastgate it passes underground, and skirts the city walls until it emerges into the open for a short distance south of Cawley Priory. Passing again underground beneath South Pallant and Southgate, it emerges near the south of the Chantrey Grounds. Hereabouts the channel bifurcates; a new cut, controlled by an iron penstock, passing directly south towards the railway station, shortly before reaching which it turns sharply westward, to join the main channel again later on.

The river proper meanwhile passes directly westward from the above point of bifurcation, and continues to skirt the city walls until it again bifurcates. One arm, which is controlled by a penstock, now passes directly westward, and continues beyond the tannery; the other arm passes underground directly northward beneath Dr. Tyacke's garden and Orchard Street, as far as the northern end of that street. Here this arm turns sharply westward, and, becoming for a short distance uncovered, receives the waters of the Campus, a channel which takes the surface drainage from Orchard Terrace and thereabouts. From this point this offset of the river passes underground in a south-westerly direction beneath the Portsmouth Road, to join its fellow at the south-western corner of the tannery, whence the united channel, which constitutes the river, trends southwards. The river having been rejoined by the "New Cut," which left it near to the Chantrey Grounds, continues in a south-westerly direction until it enters the Fishbourne Channel, near the outlet of the Chichester sewage works. The stream, in its course beneath a brewery and the tannery, receives waste products, and throughout its whole course, between the tannery and the outfall, it smells more or less strongly of tannery refuse.

In former times the Lavant received much slop-water, and not a little sewage, but these sources of pollution are now far fewer than formerly; drains are being rapidly cut off from the river, and made to discharge into the recently constructed sewer system. There were, however, at the time of my visit, sundry privies, the contents of which oozed through the bank into the channel at St. Pancras, and slop-water was here and there being cast into the bed of the stream. This state of affairs was exceptionally well marked behind some cottages, Nos. 90–94, in St. Pancras, the inmates of all of which got rid of their slop-water into the channel, and obtained their drinking water from a well hard by; on the opposite bank was an offensive privy used by the tenants of the cottages referred to. In addition to sundry sources of pollution in St. Pancras, slop-water enters the channel at intervals at other parts, and at one place, near Southgate, a house drain discharges into it. In Orchard Street there are also sundry sources of pollution. The culvert running from near Eastgate to just beyond Southgate is brick-bottomed, and by this means is kept clearer from deposit than would otherwise be the case; but beneath Orchard Street and thereabouts, where the bed of the river is

unbricked and irregular, there is a thick deposit on its bed of offensive matter.

As a general rule, there is in Chichester but little overcrowding of houses upon area; usually a curtilage of some size is attached to each house or group of houses. There are, however, exceptions to this rule; notably, in some of the poorer parts of St. Pancras, where some few houses have practically no curtilage whatever, while others abut upon the Lavant, and, as has been said, dispose of their slop-water and other refuse in the river. In spite, however, of the fact that houses, even of the poorer sort, are generally provided with curtilage, it can rarely happen that sufficient space obtains to safely allow of excrement and slop-water being deposited into one or more holes in the pervious soil, and of pure water being obtained from another. In certain of the premises which I visited the condition of the yards was extremely unwholesome; and although in some cases the houses had recently been drained, the work had been now and again done in such a careless manner that the present state of the yard surface was probably no better than before. It may, too, be remarked in regard of several houses that I visited, and which had been recently drained, that the privy vaults had, together with their contents, perhaps the accumulation of some years, been simply filled in, and not, as they should have been, carefully emptied, their bricks removed, and their sites carefully cleansed. In one case which was brought prominently to my notice, and where enteric fever was prevailing, the buried privy contents still at times made themselves manifest on the adjoining wall; and in other instances complaints of a somewhat similar nature were heard of.

It is clear that in localities where such practices have been adopted the benefits which are likely to accrue from proper drainage cannot be expected. The soil and subsoil of the city, which for years have been polluted, cannot at once be purified, more especially if the accumulated excreta of years gone by be left buried in the soil. In this sense Chichester must, I fear, still be regarded as not differing substantially from an undrained city. During the course of my inspection I had frequently related to me narratives of the discovery of cesspools in altogether unsuspected localities, and in some instances I was told that the cesspool was found located beneath the kitchen floor.

The Water Supply of Chichester.

The city of Chichester is supplied with water partly by private wells, partly by the Chichester Waterworks Company. The wells are of that kind known as "shallow"; *i.e.*, they are not sunk through any impermeable stratum, but consist of excavations sunk in the gravel overlying clay. These wells are dry-steined, and thus are but imperfectly protected against filth soaking through the soil. In the majority of instances the water is raised from these wells by means of pumps; but in some cases, especially in that part of the town which is rural in character, water is often raised by means of a windlass, and wells are covered over with wooden lids, which frequently are not so fitted as to protect them from the influx of surface water. The position of these wells was, in the great majority of cases which I inspected, a dangerous one. Frequently wells were found but a little distance removed from non-watertight privies and cesspools, to which reference will shortly be made, and it was obvious that the water contained in them was in danger of becoming fouled by infiltration of cesspool or privy contents. In numerous instances the exact position of the well was a matter of surmise only, the present tenant of the dwelling having

App. A. No. 9.

On Enteric Fever in Chichester; by Dr. Bulstrode.

had no occasion to ascertain its whereabouts. A large number of these shallow wells in Chichester have been made to furnish water for chemical examination, and many have been pronounced highly polluted. It is clear, however, whatever may be the finding of the chemist or of the bacteriologist as regards any given sample, that a very large number of the Chichester wells are in very dangerous positions.

The Chichester Waterworks Company obtain their supply from a well which was constructed in 1874, and which is situated on the Portsmouth Road at a point distant some 1½ miles west of the centre of the city. The well has a total depth of 47 feet from the floor of the engine house, the first 17 feet being lined with 9-inch brickwork, the remaining 30 feet with wrought iron cylinders. In reference to the geological strata through which the well is sunk, it may be recorded that after passing through the superficial soil and gravel, the combined thickness of which, I am informed by Mr. Shelford, the Engineer, is but a few inches, a stiff clay was encountered which continued to a depth of 23½ feet. At this point chalk marl was reached, and after penetrating this for some 2½ feet, water entered the well in large quantities. The remainder of the well shaft penetrates chalk marl and Chalk.

The water is raised by means of two engines, each capable of throwing 10,000 gallons per hour; but the total maximum average yield of the present well is, it appears, not more than some 15,000 gallons per hour. By working both engines at full speed the water may be quickly reduced to its lowest point, *i.e.*, 29 feet below the engine floor. If the engines are now stopped the well will fill up to the level of the overflow in 23 minutes, and to within 10 feet 6 inches of the floor in 12 minutes. At the present time the consumption of water in the city necessitates constant pumping, and it is contemplated, therefore, that additional borings for water will shortly be necessary. The water is pumped up into a main passing through Chichester, which it supplies on its way to reservoirs situated on the north of the city. One of these reservoirs is at the ground level, the other some 40 feet higher. The storage capacity is at present 200,000 gallons, each of the above-mentioned reservoirs holding some 100,000 gallons. The higher reservoir is for the supply of the barracks and all parts of the town that are situated above the level of the Infirmary.

The draft on the ground level reservoir (capacity 100,000 gallons), when no water is being pumped into it, is found to be about 8,000 gallons per hour, so that the capacity of the reservoir is only about 12 hours' supply.

The water from this well has been analysed on several occasions. On March 10th, 1879, Dr. J. Muter, F.C.S., pronounced the water to be "a water of very excellent quality indeed."

In April 1893, Dr. Frankland reported that "the water possesses a "very high degree of organic purity, and it is in every way well fitted "for dietetic use. It is of most excellent quality. It is slightly harder "than Thames water, but will soften down to less than two degrees "of hardness upon Clarke's scale, or 2·6 parts per 100,000."

During the prevalence of the fever outbreak to which this report relates, the water was submitted to Dr. Klein, F.R.S., for bacteriological examination, and his report thereon will be found in an Addendum.

Excrement and Refuse Removal.

Excrement is disposed of partly by means of a recently constructed sewer system, partly by means of privy cesspits and cesspools. Use in the above sense of the public sewer system is an increasing one.

The privy cesspits are capacious receptacles situated in the curtilages of the houses; they are lined mostly with brick, but not in such a manner as to render them watertight. Over the cesspits are erected commonplace privy structures, and, in numerous instances which I saw, these edifices were much dilapidated, while their floors which covered part of the pits were, not infrequently, found unsafe. The cesspits in a very large number of instances are in situations which must be regarded as unduly near the houses which they serve. They, too, are often within a few feet of the well from which the drinking water of households is derived, in circumstances which cannot fail to seriously endanger the wholesomeness of the well water. Even where the cesspits have been done away with and the houses connected with the sewers, I found, as I have said, that, in not a few instances, the cesspit had been simply filled up, and not, as it should have been, carefully dug out and cleansed. The cesspools are, like the privy pits, not watertight; they are, as a rule, covered over in such a manner as to conceal their whereabouts, and in many cases the occupier had only a very vague notion as to the locality of his cesspool. In only a few instances are they properly disconnected from drains, and some of them appear to ventilate directly into the sculleries or kitchens of the houses. Everywhere cesspits and cesspools are numerous; in fact, it would seem that the whole of the gravel upon which Chichester is built is riddled with them. Some that had been covered over and forgotten were brought to light during recent operations connected with the drainage.

The emptying of the cesspools and cesspits is left to occupiers, who exercise their own discretion in the matter. As regards some of the premises which I visited, the date, or, even the fact, of the last emptying of the cesspool could not be called to mind. It is certain, too, from the infrequency with which cesspools require to be emptied, that the greater part of their fluid contents must find its way into the gravel underlying Chichester.

Although the Town Council do not undertake the removal of excrement, they lend their assistance by letting out "tuns"* for the purpose. Doubtless the fact that a charge is made for these tuns discourages frequent emptying of cesspits and of cesspools.

The *sewer system* has but recently been constructed, and at the time of my inspection only a limited number of houses were connected with the sewers. In laying the sewers, very considerable difficulty was encountered in consequence of the subsoil water, which tends to be very abundant in the gravel soil upon which Chichester is built. Patent joints had in places to be used, and, generally speaking, leakage of the sewers occasioned much additional labour. At the date of my inspection a certain portion of the contract payment was being kept back in case of further leakage, and I have heard recently that considerable leakage still takes place. Clearly this matter should be taken in hand vigorously lest the plant at the sewage disposal works prove inadequate to deal with the sewage delivered there. The subsoil water and the rain water—save such as comes from roofs and yards—are intended to be excluded from the sewer system, and much of it finds its way into the Lavant.

The two main sewers of Chichester, pipe-sewers of 15 and 18 inches diameter respectively, converge near Westfield House. From this a culvert is continued until Rectory Road is reached, where the culvert turns south and continues down this road until just past the Rectory, where it terminates in two 15-inch cast-iron sewers in siphon. Through

* Vehicles of special construction for the conveyance of excrement.

App. A. No. 9.

On Enteric Fever in Chichester; by Dr. Bulstrode.

these cast-iron pipes the sewage flows by gravitation to the sewage disposal works, where it rises in a chamber, forming the short leg of the siphon, to the level of the sewage tanks, which are situate on the banks of Fishbourne Channel, at a point distant about $1\frac{1}{2}$ miles to the south-west of Chichester Cross in a direct line. The sewage on its arrival passes over what is termed a "salmon ladder," where it is treated with sulphates of lime and alumina. At times, when much blood is entering the sewers from the slaughter-houses, sulphate of iron is added in place of sulphate of alumina. Continuing along the "salmon ladder" the sewage enters precipitation tanks, which are furnished with the usual scum boards, sills, &c.

The supernatant sewage from these tanks passes into a concrete channel, and is from this let out by means of sluices over some $7\frac{1}{2}$ acres of land, the effluent from which passes into a large cement-lined storage tank, where it is held up until its discharge on the first three hours of the ebbing tide into the Fishbourne Channel.

The sludge from the precipitation tanks is drawn off from the bottoms of these tanks into a sludge chamber, where it is mixed with lime and pumped up into the sludge presses. The resulting cake is apparently beginning to find a sale for manurial purposes, but there was a large accumulation of it at the time of my visit. The water from the filter press undergoes re-treatment along with the sewage passing over the "salmon ladder."

The sewers are ventilated by cast-iron shafts, 30 feet in height, attached either to houses or erected at the pavement kerb, the man-hole covers being quite closed. Flushing is provided by means of flushing tanks in suitable situations.

In the course of the sewers I inspected numerous man-holes, and in no instance, although I examined the sewers at their highest points, did I notice any outrush of sewer air or any offensive smell; in fact, there was obviously no tendency to forcing out of air from the sewers at the time of my inspection, and, judging by the extremely dry weather which had prevailed previously, there would seem to be no reason why there should have been such tendency during the prevalence of enteric fever. I am informed that there is some need of further flushing tanks in certain localities, and that these will be provided when the water supply has been extended.

The *house drains* are cut off from the sewers by ordinary intercepting traps, the drains being ventilated by an inlet-shaft on the house side of the trap by means of a large pipe carried up to the level of the pavement, over the top of which is fixed an iron grating; and by the usual outlet at the distal end of the drain. Complaints were made to me on several occasions as to effluvia from these traps, and I have no doubt that now and again smells do arise from them when the house drains are discharging their contents. At the same time, I have myself passed over many hundreds of these traps in Chichester, and, although fully alive to the possibility, or rather probability, of smells emanating from them, on no occasion was I able to detect any. The iron gratings in the pavement are certainly so placed as rather to remind passers-by of the existence of the drains, and for this reason imagination may, I think, be responsible for some of the complaints. It is, too, not improbable that when the inhabitants fully appreciate the fact that these inlets communicate directly with the house drains only, and not with the sewers, objection to them will in large part cease. It is, however, possible that in certain instances the smells complained of from these ventilators—especially in cases where the house drain has not been continued into the sewer—may have been due to the unsealing,

owing to evaporation, of the trap (intervening between the sewer and the uncompleted house drain) which communicates directly by way of the air shaft with the surface. But I understand that efforts are made as far as possible to obviate this, and when all the houses are connected with the sewer it should be of very rare occurrence.

House refuse is removed twice weekly by the Town Council, and deposited upon an open space near the cemetery to the east of the town.

Isolation Accommodation.

In 1888 the Local Government Board, after local inquiry, sanctioned a loan for the purposes of an isolation hospital. The hospital is situated in the Spitalfields Road, to the north-east of the city, on a site consisting of some 3 acres of land. The present buildings consist of what is practically a slight modification of the Board's plan B., *i.e.*, of a block of six compartments, three of which face in one, and three in an opposite direction. Each group of three consists of a large ward $24' \times 18' \times 13'$, a nurses' ante-room $14' \times 14' \times 13'$, and a small ward for one bed $12' \times 12' \times 13'$. There is thus, upon a basis of 2,000 cubic feet per bed, accommodation for, say, at most eight patients in all. If, however, two diseases are being treated in hospital at the same time, there is obviously at most accommodation for but four cases of each disease, *i.e.*, three of one sex and one of the other. Clearly the accommodation is insufficient for the population of the now extended district. There is also an administrative block, consisting of a kitchen, sitting-room, and scullery on the ground floor, and three bedrooms on the first floor. In addition, there is a block of outhouses, comprising a laundry, disinfecting room, mortuary, ambulance house, fuel house, tool shed, and w.c. The ambulance is a converted brougham; but it has not been so modified as to enable a patient to be introduced into the vehicle in a recumbent position, a point of considerable importance in some instances.

The accommodation afforded by the hospital was much overstrained during the recent outbreak.

Disinfecting Apparatus.

The Town Council have not provided proper disinfecting apparatus; instead, fumigation with sulphur of clothing and bedding is practised in one of the outhouses at the hospital. It is to be regretted that the Authority possess no apparatus such as would serve for satisfactory disinfection of such articles. Possibly one of the outhouses in question might be dealt with so as to afford proper housing accommodation for a modern "disinfector," one room being used for infected, the other for disinfected, articles.

Byelaws.

At the time of the outbreak the Town Council had no byelaws in force. Byelaws, however, relating to new streets and buildings, and to other sanitary matters, have been submitted to the Local Government Board, with a view to their being put in force in the district.

Adoptive Acts.

The Infectious Disease (Notification) Act, 1889, is in force in this district, as also is Part III. of the Public Health Acts Amendment Act, 1890, and the Private Streets Works Act.

App. A. No. 9.

On Enteric Fever in Chichester; by Dr. Bulstrode.

Regulations.

The Town Council have made regulations under the Dairies, Cowsheds, and Milkshops Orders, 1885 and 1886. The cubic space required for each cow is 800 feet.

Prevalence of Enteric Fever in Chichester in former Years.

It is necessary, in order fully to apprehend the recent outbreak, to briefly consider the extent to which the city of Chichester has in former years been subject to enteric fever. In the year 1865 this city was inspected by Dr. Seaton, one of the Medical Inspectors, and afterwards Medical Officer, to the Local Government Board. In the report which Dr. Seaton made as the result of his inspection, he remarked, after examining the death returns for the seven years 1858 to 1864: "It is "at once seen that the diseases which are directly associated with "unwholesome conditions, especially gastric, enteric, or typhoid fever, "are never long absent, and sometimes considerably prevail. The "years 1861 and 1863 were the years of least prevalence of fever; in "the other five years the deaths attributed directly to this cause were "13, 13, 10, 17, and 13, respectively. . . . . . .
"It appeared, however, from the information furnished me by Dr. "Tyacke, Dr. Buckell, Mr. Elliott, Mr. Bond, and other practitioners, "that the diseases which result from unwholesome conditions prevailed "to an extent of which the death register does not enable us to make a "correct estimate; gastric or enteric fever, for instance, being very "frequent among children at an age when mortality in proportion to "attacks is comparatively small; even among adolescents and adults "the cases in proportion to the deaths seemed to have been numerous."

. . . .

"The places about Somerstown, as Cavendish Street, High Street, "George Street, and the courts running out of them,* were the places "in which fever most prevailed, and in which epidemic and other "diseases tended always to put on low types. In Cavendish Street "nearly every house has had its case or cases of fever, and in many "particular houses, in this and other streets, fever shows a constant "tendency to recur. Parts of St. Pancras were scarcely less bad."

Again in 1879 the city was inspected by Dr. Hubert Airy in consequence of an outbreak of enteric fever which was traced to infected milk. Dr. Airy in discussing the manner in which the milk became infected through the agency of previous cases of enteric fever in some cottages in St. Pancras, which abutted upon the Lavant, states that "among these cottages there was a good deal of typhoid fever in the "fourth quarter of 1878, extending into January of the present year. "One practitioner alone attended 23 cases in only six families, the "majority of them being young children. The type of the disease "was not severe; there were no fatal cases. In most of them there "was an absence of diarrhœa, and only two or three of them showed a "characteristic eruption." Further on in his report Dr. Airy observes that, "in the past nine years, 1870–8, the annual average of deaths "from fever has been 5·4 or 0·66 per 1,000 inhabitants, and the "highest number in any one year has been 10. . . . .
"The prevalence of enteric fever, which was noticed by Dr. Seaton, "still continues, as exemplified in the outbreak of last autumn in "St. Pancras."

---

* All outside the city walls.

It would seem also from evidence which was brought forward by Mr. Prior (the present Mayor of Chichester) in 1890 that, during the 18 months ended November 1889, there were no less than 65 cases of enteric fever within the Urban Sanitary District of Chichester; and further that the majority of these cases were, like those in previously described outbreaks, chiefly located in Somerstown and St. Pancras.

Such, then, is the main evidence as to previous prevalence of enteric fever in Chichester, to be obtained from special reports on the place. It will be well, however, to turn to the reports of the Registrar-General, with the view of examining how far the indications obtained in the above way are supported by the death-rates over a series of years, and it will probably be best, in order to avoid inference from insufficient numbers, if to this end reference be made to the last two Decennial Supplements, *i.e.*, those for 1871–80 and 1881–90. It should, however, be borne in mind that the Registration District of Chichester has not, until recently, been exactly coterminous with the Urban Sanitary District of that name; but seeing that the population of the Registration District which resides, or rather resided, outside the sanitary district, were under conditions more favourable to life than the Chichester conditions, there is obviously no injustice to the city in taking the figures of the Registration District.

For the purpose of comparison the death-rates from enteric fever and from continued fever for each of the Registration Districts of Sussex are given in the following table:—

Table showing Annual Death-Rates from Enteric and from Continued Fever in each of the Registration Districts of Sussex during the Decennial Periods, 1871–80 and 1881–90.

Registration District.	1871–80.		1881–90.	
	Enteric.	Continued.	Enteric.	Continued.
Ryde - - - -	0·12	0·16	0·08	0·06
Hastings - - -	0·13	0·03	0·08	0·01
Battle - - - -	0·26	0·06	0·08	0·01
Eastbourne - - -	0·25	0·05	0·10	0·00
Hailsham - - - -	0·26	0·07	0·10	0·00
Ticehurst - - -	0·24	0·05	0·06	0·01
Uckfield - - - -	0·13	0·02	0·13	0·00
East Grinstead - -	0·16	0·03	0·12	0·00
Cuckfield - - - -	0·16	0·04	0·11	0·02
Lewes - - - -	0·30	0·05	0·08	0·02
Brighton - - -	0·17	0·06	0·14	0·01
Steyning - - -	0·15	0·06	0·22	0·03
Horsham - - -	0·18	0·06	0·08	0·03
Petworth - - - -	0·23	0·04	0·14	0·00
Thakeham - - -	0·12	0·01	0·13	0·00
East Preston - - -	0·25	0·04	0·12	0·01
Westhampnett - -	0·29	0·06	0·20	0·06
Chichester - - -	**0·54**	**0·11**	**0·40**	**0·02**
Midhurst - - -	0·31	0·10	0·16	0·02
Westbourne - - -	0·28	0·03	0·28	0·00

The table serves to show that in both decennial periods the combined death-rate for enteric and continued fever in Chichester has been far in excess of such rate for any other district in the county of Sussex. In 1871–80 it reached no less than 0·65 per 1,000 and in 1881–90 had

not fallen below 0·42 per 1,000. If the objection be raised that the other Registration Districts in Sussex are not strictly parallel for purposes of comparison with that of Chichester, the reply is that during both the decades in question Chichester occupied a very unenviable position in relation to all the Registration Districts into which England and Wales was then divided, a fact which will be apparent on reference to the last two Decennial Supplements of the Registrar-General. Thus in the decennium 1871–80 there were, excluding a few Districts in which alterations had been effected, only some 31 out of 630 Districts in which the combined enteric and continued fever rates were higher than those of Chichester; and similarly in the next decennium there were but 16 Districts out of the 631 in England and Wales which had higher rates in this respect than Chichester.

Distribution in Time of Chichester Enteric Fever during 1896.

The annexed diagrams will serve to show the prevalence in time of the 111 cases of fever notified from April to September 1896 in the city, and which occurred in 76 houses. It will be seen from diagram No. I. that the majority of the cases were notified in July and August, July being the month when the disease most prevailed. Diagram No. II. shows the number of cases notified weekly during the prevalence of the disease.

Localisation of the recent Enteric Fever.

The first case of enteric fever which may conveniently be regarded as the commencement of the present outbreak was notified on April 29th, from Whyke Lane, which is situated near to the Cattle Market, on the south-east of the town and outside the city walls. After this case no further notification was received until May 24th, when a case was reported from Basin Road, immediately to the south of the city. On May 26th three cases were notified from St. Pancras, an insanitary, and, as we have seen, oft-invaded neighbourhood outside the city walls to the east of Chichester. On June 5th the first case was notified from Somerstown, a district also outside the walls, where fever has been frequently present in former years. Thereafter, during the prevalence of the disease within the district, the majority of the additional cases which occurred were notified from one or other of these two localities, *i.e.*, from Somerstown and from St. Pancras; indeed, with four exceptions, all the 76 houses invaded were outside the city walls. In other words, the localities mainly invaded during 1896 were *those which have been repeatedly invaded in former years.*

The Character of the Outbreak.

Although during the period to which this report relates there were 111 cases of enteric fever notified, not more than two* deaths occurred from this disease. This very favourable result was very possibly due in large part to the energetic manner in which the Town Council dealt with the outbreak, both as to isolation and nursing; but obviously this

* One of these was that of a man who committed suicide while in a state of delirium. At the time of his death he resided just outside the borough boundary, but the Medical Officer of Health is of opinion that the circumstances of the case justify its inclusion in the series under consideration. I am informed, by Mr. Bostock, one of the medical practitioners, that other persons dying of enteric fever in neighbouring districts may have contracted their disease in Chichester, but it is obviously difficult to include them in the present statistics.

remarkably low fatality-rate cannot be entirely explained upon this ground alone, inasmuch as the usual fatality-rate amongst hospital-treated enteric-fever cases is much in excess of that observed in Chichester. Thus, of 5,900 cases recorded by Murchison during the 23 years 1848–70, 17·3 per cent. (or, deducting the cases moribund on admission to the hospital, 15·8 per cent.) died; the extreme figures during the 23 years period in question being 28·4 per cent. and 12·82 per cent. Similarly, in the hospitals of the Metropolitan Asylums Board, to take more recent data, it is recorded in the last annual report of that Board that, among 9,884 cases of enteric fever admitted into the Board's hospitals in the years 1871 to 1895, the fatality rate at all ages was 17·5 per cent. The lowest death-rate was among patients aged from 5–10 years; after this age-period the fatality-rate gradually increased, being 27·1 per cent. among patients between 35–40 years, and 30·6 per cent. among patients aged 40 and upwards. The very trifling case-mortality at Chichester must, I consider, be referred in the main to the remarkable mildness of the majority of the cases, and consequently to the absence of those complications and sequelæ which so frequently tend to a fatal termination.

I understand, from Mr. Ernest Buckell, who had by far the greater number of cases, as also from Dr. Arthur Buckell, that complications and sequelæ were rare, and that the early cases which occurred were of a mild type. In the opinion of both these gentlemen the disease gradually increased in severity as the outbreak progressed, the later cases being, many of them, of considerable severity. This I can confirm, since some which I was asked to see at the Fever Hospital exhibited symptoms of enteric fever particularly well developed, more especially as regards eruption.

Besides definite fever attacks, there occurred in families affected many cases of diarrhœa and general sickness which manifested themselves during, or shortly subsequent to, the appearance of fever in the invaded dwellings. This was very common, and often some of the symptoms of the sufferers appear to have borne resemblance to those of enteric fever. In some instances only one member of the family appears to have been thus affected by anomalous illness; in other instances many of the inmates were affected in some degree. Whether these cases are to be regarded as amounting to abortive attacks of enteric fever is a question which the information at my disposal does not enable me to answer, but judging from the anomalous symptoms at times observed among the inmates of houses invaded by such diseases as diphtheria and scarlet fever, as also, perhaps, cholera, such belief may, in time to come, be found to receive support at the hands of the bacteriologist.

Incidence of the Fever upon Sex.

Out of 111 cases of enteric fever notified from April 29th to September 12th inclusive, 49 were females and 62 males. As the estimated number of females in the city is 5,841 and that of males, 4,967, it is clear that the incidence of the fever on the female population has been lighter than that on the male: *i.e.*, on the former 0·8 per cent.; on the latter 1·2 per cent.

Age-Distribution of the Fever Attacks.

The chief incidence of the disease was upon the age-period 5 to 20 years, there being within this age group no less than 63 attacks out of the total 111 of which this report treats. The three quinquennial

periods embraced within the above age-group have yielded respectively from lowest to highest 20, 30, and 13 attacks.

The accompanying diagram (No. III.) will serve to illustrate these points.

The Public Water Supply in relation to the Prevalence of Enteric Fever.

It has been seen from the chemical and bacteriological analyses already referred to that the experts to whom the Chichester Waterworks water has been from time to time entrusted for examination have pronounced very favourably upon it. Dr. Klein, be it noted, made his tests of the water at the very time that the epidemic was in progress, and it is unlikely, from the bacteriological view point, that a water actually disseminating enteric fever could yield so satisfactory a result as that recorded by him under date of 31st July. It is, of course, conceivable, but in the present instance altogether improbable, that the water had been subject from time to time to transient specific pollution, so as to have been enabled to disseminate fever.

The facts, however, as to the distribution of the invaded houses in Chichester, are not such as to lend any support at all to a thesis of fever conveyed by a water service specifically contaminated at its source. The public water supply is conveyed to all parts of the district, and yet, as has been seen, the parts of the city, within the city walls, which are largely supplied with water from the public service, were only but very slightly affected. Of the 682 houses within the walls, 494 were supplied with the company's water, and of these only three were invaded by enteric fever. Furthermore, it has to be noted that out of the 76 houses which were invaded in the whole district, 39 were supplied with well water, and 37 with water from the company. These figures give, taking the whole of the houses (2,722) in the district, an incidence of enteric fever on the 1,393 houses supplied by the company of 2·6 per cent., and on the 1,329 houses supplied with well water 2·9 per cent.

As to possible local fouling of particular water mains serving the localities chiefly affected by the fever, it has to be recorded that the distribution of the several water mains in Chichester is not such as would lend any support to explanation in this way of the outbreak.

The Sewerage System in relation to the Outbreak.

The fact that epidemic enteric fever manifested itself in certain parts of Chichester shortly after the completion of the new sewerage system has sufficed to convince certain persons in Chichester, more especially persons who throughout have been in opposition to the scheme, that the outbreak has been due to the sewers. It becomes, therefore, of importance to consider how far, if at all, the sewers are to be thought of as having caused or having contributed to the fever prevalence. In the event of the sewers having been responsible, it would seem reasonable to expect, taking the town as a whole, that there should have occurred, if not an exclusive incidence of the disease upon the "drained" houses, at least a much heavier incidence upon them that upon the "undrained" houses; a speciality of incidence to be anticipated whether on a thesis of the disease having been caused by sewer air from the house drains, or upon one which seeks to account for it by the recent disturbance of polluted soil. It became apparent, however, from an examination of the invaded houses that no exceptional incidence had occurred on those which are drained to the sewers. Of the 76 invaded houses, 50 were "undrained"

App. A. No. 9.

On Enteric Fever in Chichester; by Dr. Bulstrode.

and 26 "drained"; further, the per-centage incidence on the whole of the undrained houses in the town was slightly in excess of that upon the whole of the drained houses.

Moreover, a thesis which refers to sewer influence the exceptional incidence of the disease in 1896 on the poorer districts of Somerstown to the north-west of the city, and of St. Pancras and the Hornet on the east of it, is the less satisfactory since in former years, when there was no sewerage system, the incidence of enteric fever has always been on the same localities. Similarly, such thesis is in want of justification in view of the absence of the disease in 1896 in the intramural portions of the city, the houses of which are sewered to a greater extent than those outside the walls. Inside the walls there was but one "drained" house invaded. It is true that had the portions of the city specially affected in 1896 been free from fever prevalence in previous epidemics, a theory that the highest parts of the town suffered most because most exposed to escape of concentrated sewer air, might have been provisionally entertained. But even here the advocates of such a theory would have been brought face to face with the difficulty that the incidence of the enteric fever was as great on dwellings not connected with the sewers as on houses connected therewith, and would be confronted with the further fact that, as has been already recorded, no conditions obtained antecedent to, or during, the prevalence of enteric fever in 1896, of a sort to give rise to extra pressure within the sewers, and to consequent displacement from them of sewer air.

Milk Supply in relation to the Outbreak.

The 76 households invaded during the prevalence of enteric fever to which this report relates, were supplied with milk from no less than 19 different sources, while in some condensed milk only was used. These facts would appear sufficient to exclude milk as having had any important concern in the prevalence of the disease in the present instance.

Rainfall in relation to the Outbreak.

I am indebted to Dr. Tyacke for data relative to the local rainfall. From them it will be seen that the period preceding and accompanying the outbreak was, with the exception of the month of June, characterised by but little rainfall :—

——	Average Rainfall for 50 Years, 1839–88.	Monthly Rainfall in 1896.
	Inches.	Inches.
January	2·67	0·97
February	1·97	0·49
March	1·81	3·11
April	1·58	0·52
May	1·87	0·48
June	1·90	3·27
July	2·28	1·11
August	2·38	1·46
September	2·93	*8·09
October	3·59	3·20

* The rainfall for September 1896 was, Dr. Tyacke tells me, the highest on record, the nearest approach to it being 6·18 inches in September 1866.

App. A. No. 9.

On Enteric Fever in Chichester; by Dr. Bulstrode.

The single case of enteric fever which occurred in April, and the few cases notified in May, would appear to lend no support to a thesis of displacement of infected ground air by the heavy rainfall of March; nor would the small rainfall in July seem to afford adequate explanation on a similiar hypothesis of the excess of incidence of the disease in August.

Upon the whole, it does not seem, from a consideration of such factors as have elsewhere been found instrumental in disseminating enteric fever, that any one of these has been conspicuously operative during 1896 in Chichester. It has, however, been clearly shown that in the past this city has suffered in an altogether exceptional degree from enteric fever, and it would seem that, notwithstanding improvements effected in the place, the conditions which have tended to set going and to establish this state of affairs are still potent for harm. There would, indeed, appear from a consideration of the past history of Chichester in respect of enteric fever, no need to seek out in explanation new agencies of dissemination, such, for instanee, as the public water supply, or the recently constructed sewerage system. It has already been shown that prior to the introduction of either of these new conditions, enteric fever prevailed in a very pronounced fashion in Chichester; that in years gone by the town must have suffered to a greater extent from enteric fever than has been the case during the period to which this report especially relates. For instance, it appears from Dr. Seaton's report already referred to, as also from the Registrar-General's annual reports, that in certain years the deaths from "fever" have amounted to 11 and 12, and even 17, whereas in the prevalence to which this report relates the deaths were but two.

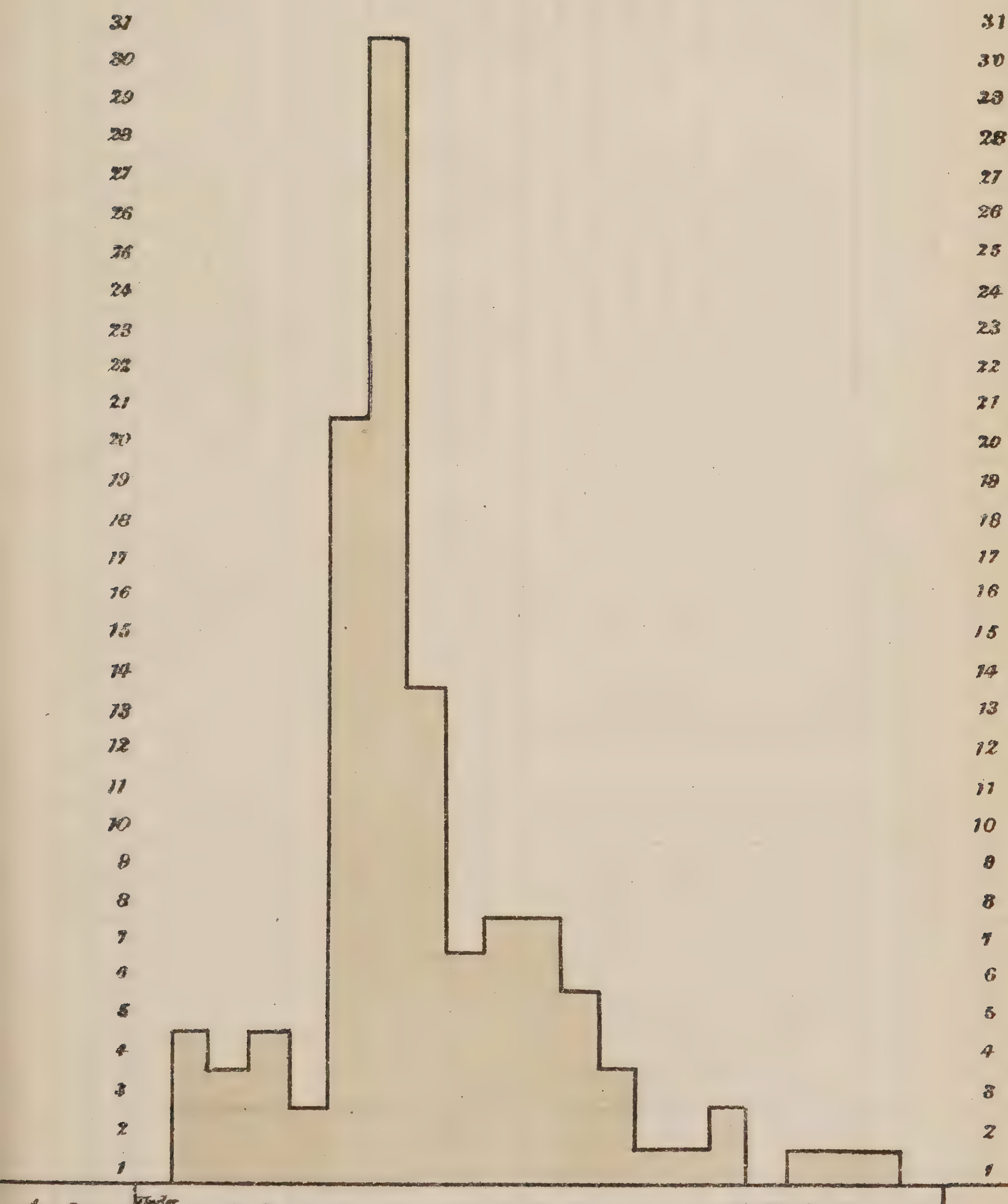
What has been the dominant cause of the endemicity, past and present, of enteric fever in Chichester, it is not easy to determine, but it would seem difficult to exonerate the filthy cesspools and privies which have abounded, and which still to a very large extent abound, in Chichester, in positions such as to guarantee the pollution both of the soil and the subsoil of the city. There is presumption, indeed, that these filthy conditions have had principal concern with the fever.

There is solace in the consideration that the sanitary condition of Chichester is improving as a result of the extension of the public water service, and of the adoption of the water carriage system of excrement removal in place of the filthy and dangerous system of storing up excrement in the vicinity of dwellings. It is to be expected, too, that when the new byelaws are in force, alteration and reconstruction of house drainage will be performed upon a more modern and uniform basis than has hitherto, without the assistance of proper byelaws, been feasible. But not until the cesspits and cesspools of the place have been abolished, and their sites and the soil in their neighbourhood thoroughly cleansed, can it be hoped that enteric fever will be banished from the city.

CASES OF ENTERIC FEVER NOTIFIED IN CHICHESTER, 1896.

Wyman & Sons, Ltd, Lith 9309.6.97.

Diagram No. III. Illustrating the Age-Incidence of Enteric Fever in Chichester, 1896.



Wyman & Sons, Ltd, Lith, 9509. 6.97

ADDENDUM.

App. A. No. 9.

On Enteric Fever in Chichester; by Dr. Bulstrode.

Report of Bacteriological Analysis of the Chichester Public Water Supply by Dr. Klein, F.R.S.

"The water was limpid, and on standing there was no visible sediment.

"The bacteriological examination was made in the following manner:—

"(1.) An ordinary gelatine plate was made with $\frac{1}{4}$ c.c. of the water, to determine the number of aërobic microbes. This plate yielded after 48 hours' incubation at 21° C. 23 colonies, that is to say, the water contained 92 aërobic microbes per 1 c.c.

"This is a small number of microbes. They were all of the nature of harmless water bacteria.

"(2.) 1,200 c.c. of the water were driven through a Berkefeld filter, and the whole of the particulate matter obtained therefrom was brushed off from the outside of the filter, and submitted to examination in order to detect the presence of bacillus coli, or varieties of this microbe, or of the typhoid bacillus. For nutritive media, phenolated broth, phenolated gelatine, and iodised potato gelatine were used. By means of cultures in these media, sewage microbes, *e.g.*, proteus Zenkeri, bacillus coli and its varieties, and the typhoid bacillus are best detected. In none of the above cultivations were any of these microbes detected; in fact, these cultures, although each received the particulate matter of 120 c.c. of the original water, remained sterile.

"(3.) The particulate matter of 120 c.c. of the original water was tested as to the presence of anaërobic microbes. None were found."

From the results of the above examination it follows that the sample of water delivered here was of excellent quality as far as bacteriological tests go.

July 31st, 1896.

Copy of Recommendations made (July 21st, 1896) to Town Council.

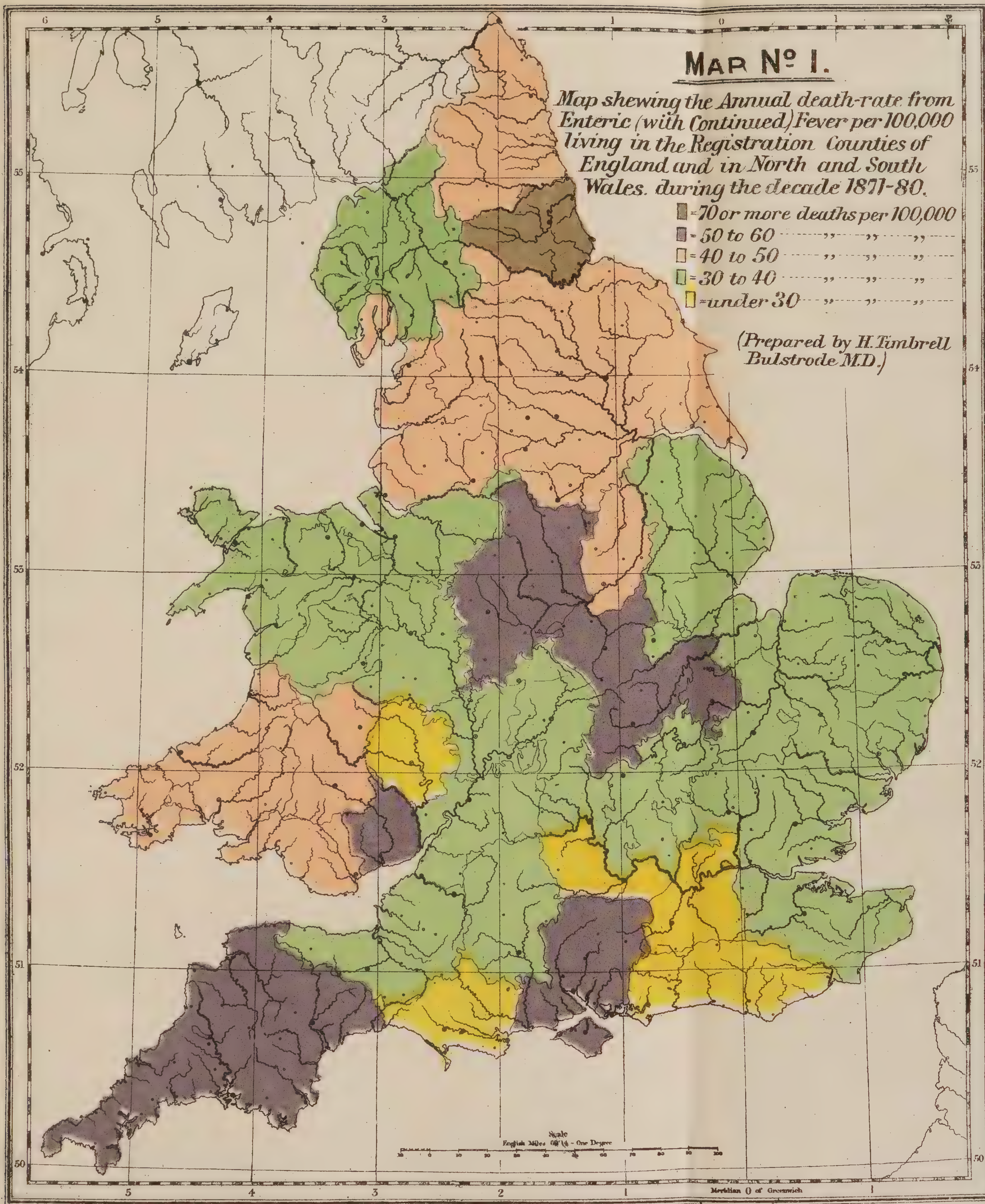
1. With the object of removing or mitigating such conditions as may foster and spread enteric fever, a house-to-house inspection of the invaded localities should forthwith be made. In this inspection special regard should be had to all accumulations of filth, and where these are found they should be at once removed with all proper precautions.

2. When a case of enteric fever occurs, the patient should be (as has hitherto been the case), if possible, removed to suitable isolation accommodation, the premises duly cleansed, and infected articles disinfected or destroyed. The privy and cesspool (if such exist) should be at once emptied with a liberal use of disinfectants. In cases where removal to hospital is not feasible, the greatest care should be taken in regard to the immediate disinfection of the excreta (both liquid and solid) of the patient; and if the water for the household is obtained from a local well caution should be exercised in the ultimate disposal of the excreta. If the house is drained, the excreta, after thorough disinfection, may pass into the sewers.

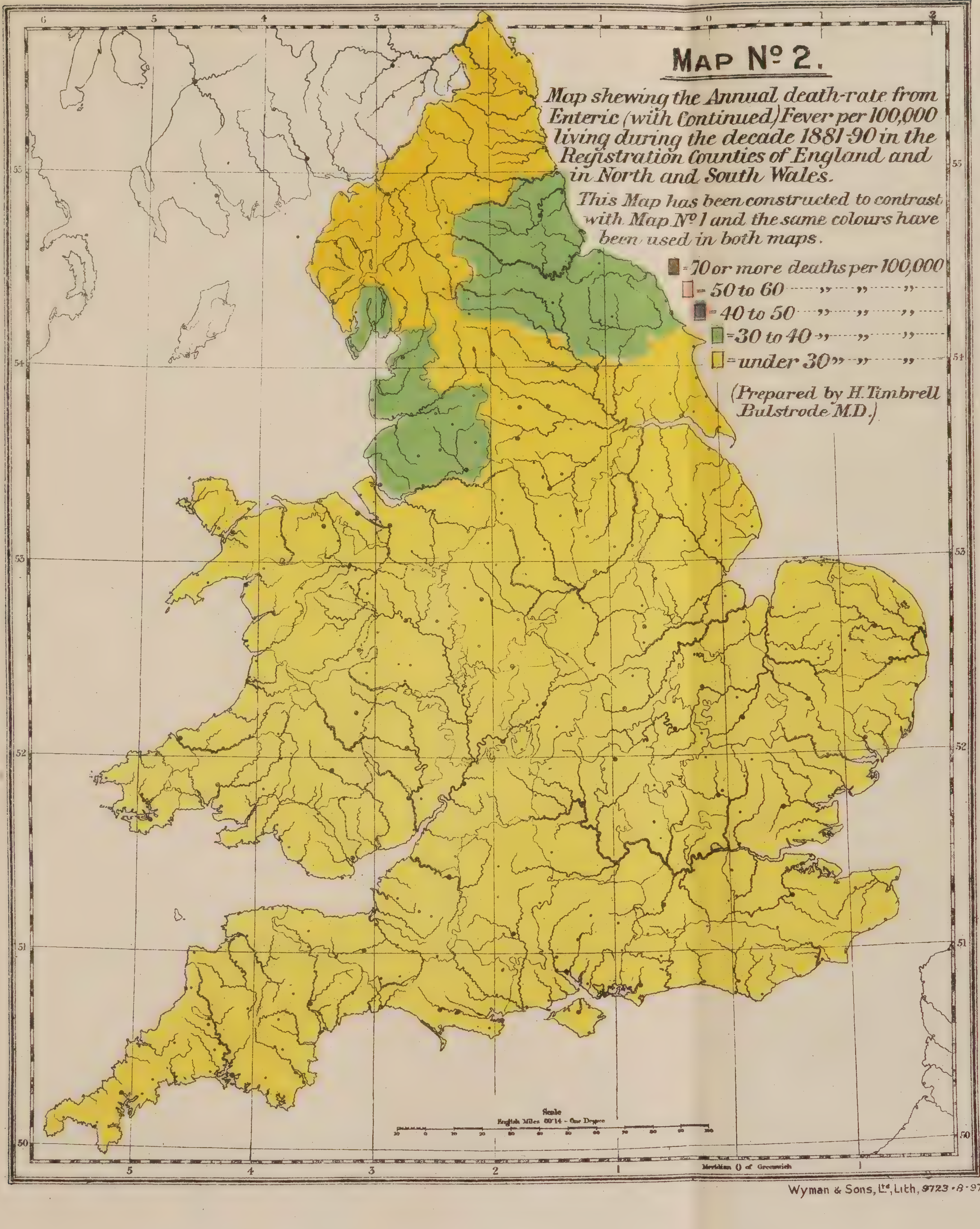
3. In premises where the well water is liable to pollution by reason of soakage from the surrounding soil, as, for instance, from privies or cesspools, the inmates should be cautioned as to the danger they incur in continuing to drink such water. House drains and sewers should be kept well and regularly flushed.

4. Use should be made of the house-to-house inspection, to impress, where necessary, upon the inhabitants, the desirability of adopting the water carriage system of excrement disposal, and in cases where this system is being, or has been, adopted, the disused privies should be

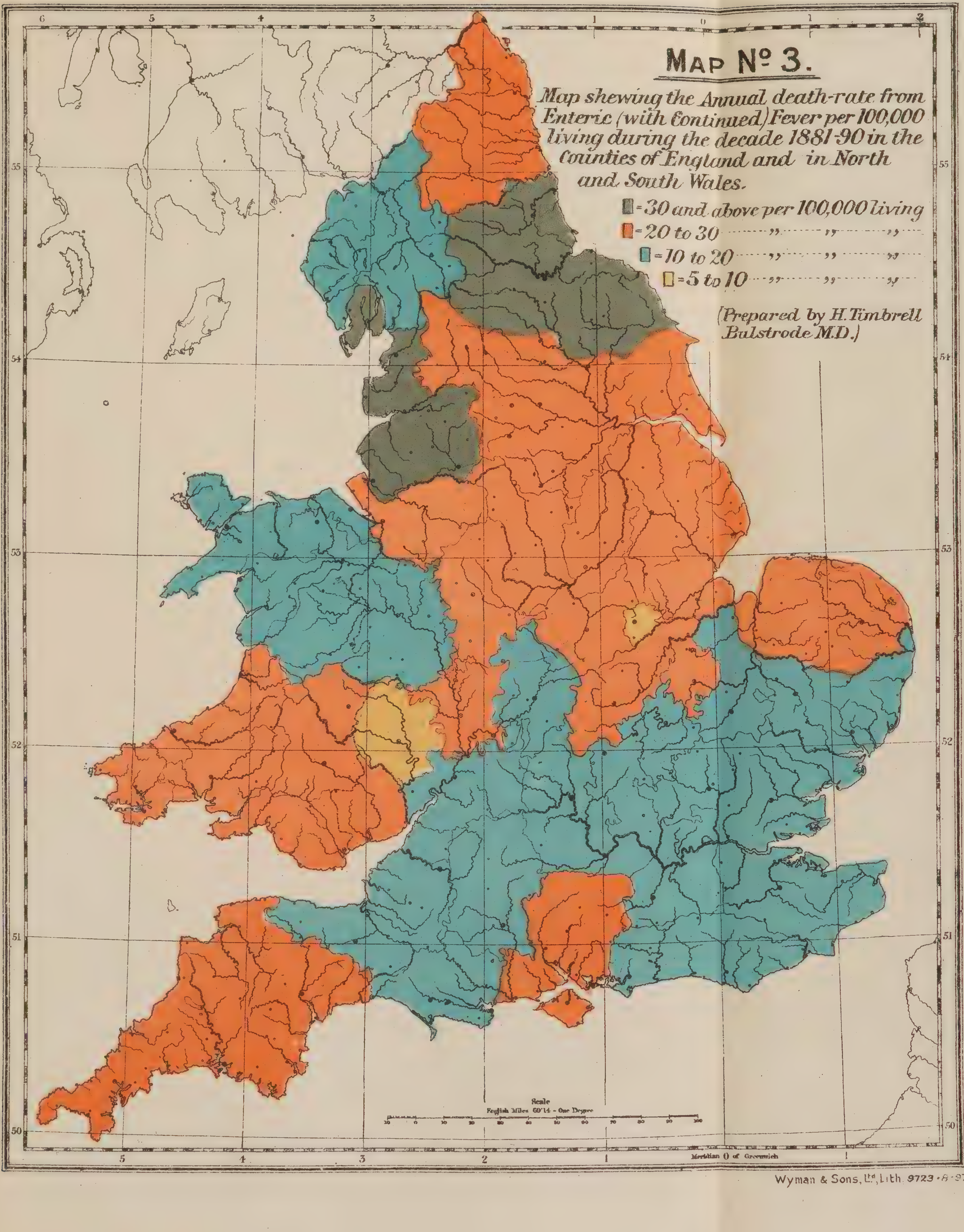
thoroughly cleaned out and the brickwork lining then removed. In no case should the privy be filled up while it still contains excrement. In carrying out these recommendations, general regard should be had in matters of detail to the principles set forth in the "General memorandum "on proceedings which are advisable in places attacked or threatened by "epidemic disease," issued by the Local Government Board.



Wyman & Sons, Ltd. Lith. 9723 · 8 · 97.



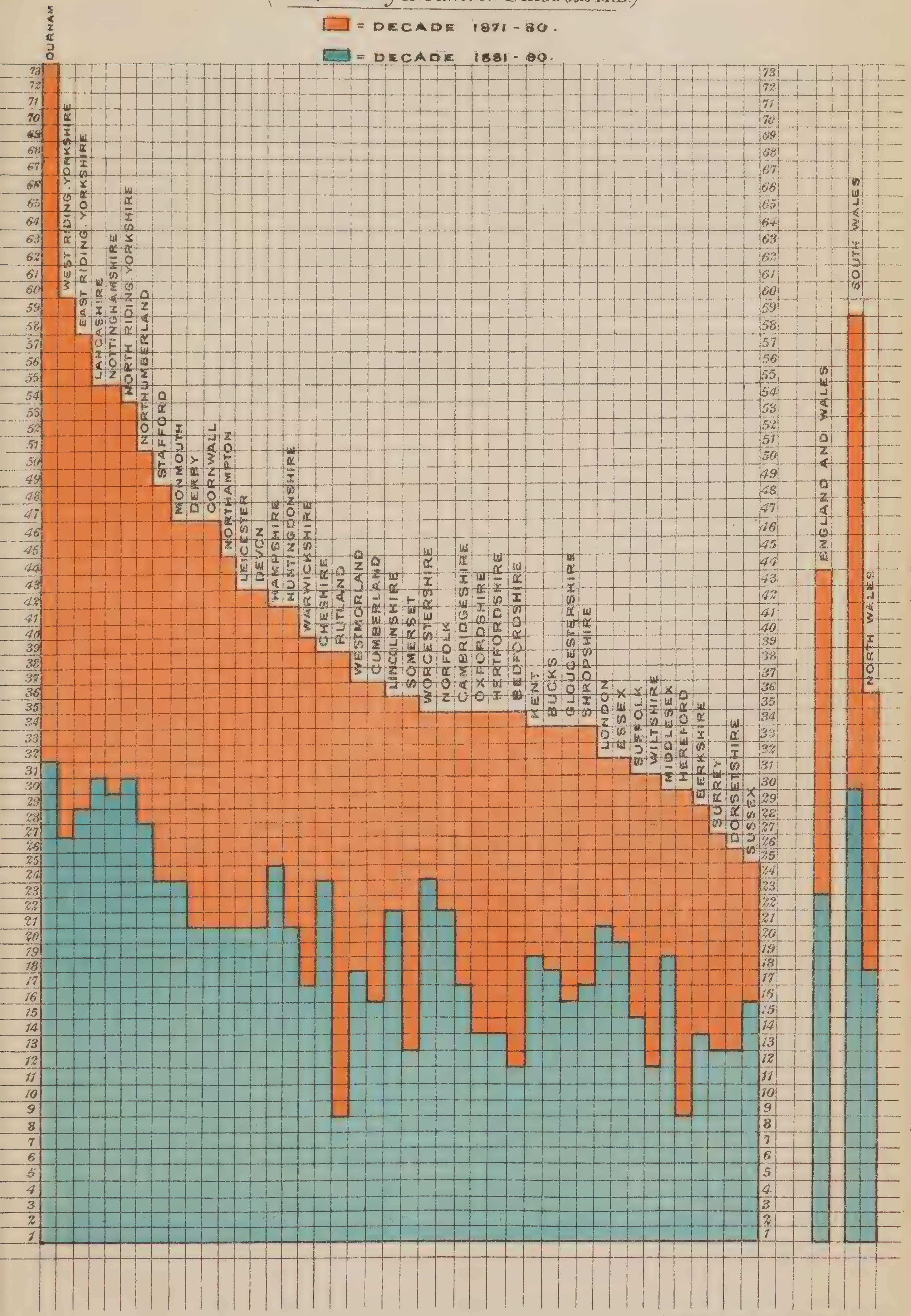
Wyman & Sons, Ltd, Lith, 9723 - 8 - 97.



Wyman & Sons, Ltd, Lith. 9723 · 8 · 97.

Chart shewing the Annual Death rate from Enteric (with Continued) Fever per 100,000 living, in the Counties of England, and in North & South Wales during each of the Decades. 1871-80 and 1881-90.

(Prepared by H. Timbrell Bulstrode M.D.)



Wyman & Sons, Ltd, Lith 9723. 9. 97.

No. 10.

App. A. No. 10.

On Diphtheria in Gillingham, in relation with School Attendance; by Dr. Sweeting.

REPORT on the PREVALENCE of DIPHTHERIA in the GILLINGHAM URBAN DISTRICT, with especial reference to the Question of RESTRICTION on SCHOOL ATTENDANCE; by Dr. R. DEANE SWEETING.

Twenty-one deaths from diphtheria having been recorded in the Registrar-General's Return for the first quarter of 1896 as occurring in the Gillingham Urban District, and twenty-nine more deaths from the same disease having been reported to the Board by the Medical Officer of Health of that district as having occurred in the second quarter of the year up to June 20th, inquiry was ordered by the Board. On being instructed to make this inquiry, I was commissioned to make special investigation into the circumstances under which a certain school in the district had been closed on account of the prevalence of diphtheria.

Gillingham Urban District is situated partly north and partly north-east of the Urban District of Chatham, and north-east of the city of Rochester, being practically continuous with each of those districts. Its area is 4,302 acres. The number of inhabited houses, and the population, at the censuses in 1881 and 1891, and as estimated for 1895, are as follow:—

Year.	Number of Inhabited Houses.	Population.
1881 - - - - - -	3,416	20,644
1891 - - - - -	5,144	27,872
1895 (estimated) - - - -	5,615	31,683

It is divided into three wards, viz.: Gillingham, New Brompton, and Brompton, certain particulars of which are shown in the following table (A.):—

TABLE A.

Showing, as estimated to the middle of 1895, for each of the Wards of the Gillingham Urban District, the Area in Acres, Number of Inhabited Houses, Population, Population per House, and Population per Acre.

Ward.	Area in Acres.	Number of Inhabited Houses.	Population.	Population per Acre.	Population per House.
Gillingham - -	2,923	1,110	6,250	2·1	5·6
New Brompton -	662	3,935	19,228	29·0	4·9
Brompton - -	717	570	6,205*	8·7	10·9
Gillingham Urban District - -	4,302	5,615	31,683	7·4	5·6

* Including that of the barracks and dockyard extension.

Of these three wards Gillingham, situated in the east of the district, is of a semi-rural character, and sparsely populated; Brompton, the most westerly ward, consists of old property and many courts and alleys,

and has the greatest population per house (which is largely due to the presence of the barracks), whilst New Brompton, in the centre, is more densely populated in area, consisting of numerous new streets. A large proportion of the inhabitants of the district is engaged in Government employ at the dockyard. The ground rises gradually towards the north and east of the district, and is more or less undulating throughout.

Geologically, the whole district is on the Chalk, which is overlaid in the northern parts by several distinct beds of Thanet Sand. There is a variable depth of soil above the Chalk and Thanet Sand; but in some parts the Chalk is very near the surface.

The following table (B.) shows the number of notifications and deaths from diphtheria in the Gillingham Urban District from 1890 to the present time:—

Table B.

Showing the Notifications of Diphtheria and Deaths from that Disease in the Gillingham Urban District from 1890.

Year.	Number of Notifications.	Number of Deaths.
1890 - - - - - -	10	3
1891 - - - - - -	13	3
1892 - - - - - -	15	6
1893 - - - - - -	18	7
1894 - - - - - -	4	—
1895 - - - - - -	5	3
1896. 1st quarter - - - -	52	21
2nd ,, - - - - -	92 } 152	30 } 52
to July 23rd - - - -	8	1
1890–1896 (July 23rd) - - -	217	74

Besides the 52 deaths from diphtheria in 1896, there were nine deaths registered from other throat diseases commonly found to be closely allied to, if not identical with, diphtheria, *e.g.*, croup, ulcerative croup, membranous laryngitis. This raises the mortality to 61 deaths.

The next table (C.) shows the number of notifications and deaths from diphtheria, which occurred in 1895 and 1896.

Table C.

Showing the Number of Notifications and Deaths from Diphtheria in the Gillingham Urban District in 1895 and 1896.

Year.	Month.	Number of Notifications.	Number of Deaths.
1895 - - -	August - - -	1	1
,, - - -	October - -	1	1
,, - - - - -	December - - -	3	1
1886 - - -	January - - -	9	4
,, - - -	February - -	21	10
,, - - -	March - -	22	6
,, - - -	April - -	25 } 144	7 } 50
,, - -	May - - -	26	6
,, - - -	June - -	41	17
,, - - -	July (to 23rd) - -	8	1
		157	54

From a consideration of Table B. it is seen that fatal diphtheria has not been absent from the Gillingham Urban District since 1890, except in the year 1894. But it has only been since the beginning of 1896 that the disease has assumed any large dimension. A rise in notifications and in mortality began (Table C.) in February of this year, being on the whole maintained until June, when a further rise occurred. The incidence on the Gillingham Urban District during the first two quarters of 1896 was equal to an annual attack-rate of 9·0 per 1,000 living, and a mortality rate of 3·2 per 1,000 per annum.

The next table (D.) shows the number of notifications and deaths from diphtheria quarterly in 1895 and 1896 (to June) in the neighbouring urban districts of Rochester and Chatham, compared with those in the Gillingham Urban District.

Table D.

Showing the number of Notifications and Deaths from Diphtheria quarterly in 1895 and 1896 (to June), in the Rochester, Chatham, and Gillingham Urban Districts.

Year.	Quarter.	Rochester Urban District, Population, 28,682.		Chatham Urban District, Population, 31,657.		Gillingham Urban District, Population, 31,683.	
		Notifications.	Deaths.	Notifications.	Deaths.	Notifications.	Deaths.
1895 - -	1st -	3	—	3	1	—	—
,, - -	2nd -	3	—	3	1	—	—
,, - -	3rd -	6	—	2	—	1	1
,, - -	4th -	82	15	21	8	4	2
1896 - -	1st -	64	15	58	15	52	21
,, - -	2nd -	16	2	24	6	92	30

Fatal diphtheria, therefore, manifestation of which appeared in the Rochester Urban District in the fourth quarter of 1895, and marked excess of which showed itself in the Chatham Urban District in the same quarter of that year, did not appear to any conspicuous extent in the Gillingham Urban District until the first quarter of 1896. During the second quarter of 1896 it continued to increase in the Gillingham Urban District, whilst it diminished in the Rochester and Chatham Urban Districts. Of the total 152 cases of diphtheria notified in the Gillingham Urban District up to July 23rd, 1896, none occurred in Brompton ward, only three in Gillingham ward, of which one was fatal, and the remainder in New Brompton ward, to which ward the outbreak has, therefore, been practically confined.

The three wards of the Gillingham Urban District have already been contrasted in certain particulars, from which it has been seen that the New Brompton ward considerably exceeds the other two in density of population per acre. As regards its sanitary circumstances, it may be said to be superior to the other two, particularly to the Brompton ward, where many grave nuisances and much dilapidated property still abound. Water supply, derived from springs in the Chalk, is common to all three wards, and is reported to be of excellent quality. Cesspool drainage, too, is common to all three wards, though this is in process of abolition throughout the whole district; a loan for 24,000*l.* having been

App A. No. 10.

On Diphtheria in Gillingham, in relation with School Attendance; by Dr. Sweeting.

sanctioned by the Board for main drainage, which is in process of rapid execution. The main drains have already been completed in Gillingham ward, and in one-third of New Brompton ward, though the house-connections are not yet made in either place.

A theory of causation of diphtheria in the district by disturbance of soil owing to these drainage operations was seen not to be borne out by the facts elicited.

As for defective sanitary circumstances, I visited the houses where the 1895 cases and the early cases in 1896 had occurred; but I could find no difference between them and the houses generally in New Brompton ward in this respect. In point of fact, New Brompton ward is, in regard of such circumstances, distinctly superior to Brompton ward, which contributed not a single case to the outbreak.

I was informed that building operations had been very actively carried out in New Brompton ward of late years, and that houses are no sooner built than they are occupied, often when not perfectly dry. Again, that this ward contains a relatively larger number of young married couples than the other two wards, and consequently a larger number of children of school age; in connexion with which latter statement it may be mentioned that of the 144 notifications of diphtheria in the first two quarters of 1896, 112 were between 3 and 12 years of age, and that 45 of the 50 deaths during that time were within the same age-limit.

These two factors, viz., the premature occupation of new houses and the large number of susceptible children, coupled with the relatively high density of the population of New Brompton ward, may perhaps not unreasonably be held to have had some concern with the disproportionate incidence of fatal diphtheria on that ward.

It has already been shown that diphtheria prevailed in Rochester and Chatham Urban Districts before the outbreak in Gillingham Urban District. Now, not only are all these three urban districts practically one community, but New Brompton ward is topographically the nearest to Chatham Urban District. It is, therefore, of some significance, in respect of the distribution of the disease, that during the period covered by the fourth quarter of 1895 and the first and second quarters of 1896, of 103 cases of diphtheria notified in the Chatham Urban District, 55 occurred in a portion of that district immediately west of the Luton Road, and closely contiguous to the New Brompton ward of the Gillingham Urban District.

There seems some ground, therefore, for holding that diphtheria owed its appearance in epidemic form in the Gillingham Urban District in 1896 to extension from Rochester and Chatham, where it had previously prevailed.

The measures taken by the Gillingham Urban District Council to combat the outbreak comprised (1) hospital isolation; (2) fumigation; (3) exclusion of particular children from school and closure of schools.

(1.) The Gillingham Hospital, built out of current rates, contains on the ground floor two eight-bedded wards, separated by a kitchen common to the whole establishment and by two nurses' sleeping rooms. On the first floor are the caretaker's sitting-room and bed-room. The wards, kitchen, sleeping, and sitting-rooms are in aërial communication with each other. Two tents, holding four more beds, were recently erected in the grounds, to supplement the accommodation in the wards, making 20 beds in all. Each ward is provided with a water-closet, which opens directly into the ward without any intervening cross-ventilation. There is a very small and inadequate laundry, and no proper disinfecting apparatus. The hospital may, indeed, be considered to be both unsatisfactory and inadequate. The Medical Officer of Health, Mr. Warren,

informs me that only about one-half of the cases notified in 1896 have been isolated there.

(2.) There is no disinfection of infected clothing or bedding. All that has been done in the way of disinfection has been sulphur fumigation of houses and rooms where infectious disease has occurred.

(3.) Exclusion of children from school on account of diphtheria in their families was carried out on the advice of the private medical practitioners, at the instance of the Medical Officer of Health. Further, two schools were closed, viz., the infant department of the Wesleyan School, and the Byron Road Board School. The former was closed for a fortnight from June 10th on the personal recommendation of the Medical Officer of Health. But at the expiration of that time the managers dismissed the scholars for the summer holidays, and the school was not re-opened until the end of July. The Byron Road Board School was closed from June 2nd to July 6th. This school, the number on the books of which is 932, and the average attendance at which during the month before closure was 785, is a well-built and well-arranged modern structure, under the management of the Gillingham and Grange School Board. No complaint or allegation as to any insanitary circumstances has ever been made against it, and I discovered none when I visited it.

The proceedings adopted with regard to the closure of Byron Road Board School came under a good deal of local criticism, and there will be advantage in dealing with this subject in some detail.

On May 30th, 1896, the Medical Officer of Health verbally intimated to the Chairman of the Gillingham and Grange School Board that closure of the Byron Road Board School was necessary. The grounds upon which he adopted this course were as follow :—

That of 26 cases of diphtheria notified in May 1896, 23 occurred in children attending one or other of the elementary schools; that of these 23 children 18 attended the Byron Road Board School; that of these 18 Byron Road Board School attendants, 11 were the first to be attacked in the families to which they belonged; that all the five cases of diphtheria notified on May 28th were attendants at that school; that during the week May 24th to May 30th, there was a special incidence of diphtheria on the Byron Road Board School, whereas inquiry failed to show that attendants at the three other public schools of the district were being specially attacked ; that the special incidence on school children generally, and on the Byron Road Board School in particular, had become a new phase of the outbreak.

On the conveyance by the Chairman of the School Board of the verbal intimation of the Medical Officer of Health to the School Management Committee on June 1st, the school at Byron Road was directed to be closed for a fortnight from June 2nd. On June 11th the Medical Officer of Health states that he attended the meeting of the School Board, and recommended that Byron Road School should be kept closed for a week longer than the period originally specified, viz., until June 23rd.

There is, however, no entry of this recommendation in the minute book of the School Board, which contains the following : "Dr. Warren "attended, undertook to let clerk have list of children where there was "infectious disease in the house, with a view to their being kept away "until infection was supposed to be past." In the minutes of the School Board meeting on June 25th it is stated: "Clerk stated that he "had seen Dr. Warren on the subject of re-opening of the schools, and "the doctor had given it as his opinion that it would be unwise to do "so at present, but thought that there was ground for hoping that they

App. A. No. 10.

On Diphtheria in Gillingham, in relation with School Attendance; by Dr. Sweeting.

"might be open for resumption of duty on July 6th." At this meeting it was proposed, seconded, and carried by the acting chairman's casting vote:—

"That the Medical Officer of the district" (meaning the Medical Officer of Health) "having closed the Byron Road School (900 children) "for over three weeks, and this Board having received no further "report from the sanitary officer, consider the further closing to be "unreasonable." This resolution was reported in the local press, and it was regarded both by the Chairman of the School Board and others as a "vote of censure" on the Medical Officer of Health. In spite, however, of the resolution, the Byron Road School remained closed until July 6th.

On July 3rd a special meeting of the School Board took place. The so-called "vote of censure" on the Medical Officer of Health was, after what would appear to have been a heated discussion, rescinded by a large majority.

On July 9th, at an ordinary meeting of the School Board, a letter was ordered to be sent to the Gillingham Urban District Council embodying a resolution asking the latter Council to furnish the School Board with lists of children suffering from infectious disease, so that steps might be taken to exclude them from school. This letter was despatched on July 14th, and was referred by the Gillingham Urban District Council to their Medical Officer of Health. At the same meeting of the School Board, on July 9th, two letters were received from the Medical Officer of Health to the Gillingham Urban District Council, one (undated) giving his reason for having closed the Byron Road School on June 1st, the other (dated July 6th) giving his opinion that that school might then be re-opened.

The above proceedings call for comment, in connexion with the "Memorandum on the circumstances under which the closing of public "elementary schools, or the exclusion therefrom of particular children, "may be required in order to prevent the spread of disease." This memorandum embodies the terms of Article 88 of the Code of Regulations approved by the Lords of the Committee of Council on Education, which is to the following effect:—

"The Managers must at once comply with any notice of the sanitary authority of the district in which the school is situated, or any two members thereof, acting on the advice of the Medical Officer of Health, requiring them for a specified time, with a view to preventing the spread of disease, or any danger to health likely to arise from the condition of the school, either to close the school or to exclude any scholars from attendance, but after complying they may appeal to the Department if they consider the notice to be unreasonable."

From this document it will be seen that no recommendation, intimation, or request as to the closing of a school is valid unless it be in the form of a notice of either the local sanitary authority or of any two members thereof; and that the duty and power of the Medical Officer of Health in regard to school-closure is limited to advising his authority that such closure is requisite with a view to preventing the spread of disease.

In taking upon himself to deal in person with the School Board, as with the chairman and the clerk, by conversation and correspondence with them, as well as by attendance at meetings of the School Board concerning matters in which his action should have been governed by Article 88 of the Education Code, the Medical Officer of Health acted irregularly, with whatever praiseworthy motive he was actuated. It was without doubt due to the frequent and close personal relations

On Diphtheria in Gillingham, in relation with School Attendance; by Dr. Sweeting.

between the School Board and himself that led that Board to assume that they had a right to his services in connexion with school operations, and this in turn led to the passing of the so-called "vote of censure" by a public body to whom the Medical Officer of Health stands in no official relation whatever. The Medical Officer of Health stated to me that the action which he took was largely due to the fact that in February 1896 he obtained the sanction of the Gillingham Urban District Council "to close schools in the district on account of diphtheria, if necessary;" but no such authorisation can in any way set aside the precise terms of Article 88 of the Code. In this case, too, any such authorisation must have been verbal only, for I can find no record of it in the minutes either of the Council or of its sanitary committee.

Again, the letter from the Medical Officer of Health, in which he stated, on July 6th, that he then considered "it fit for the Byron Road "School to be re-opened," was equally irregular, in so far as it may have been meant to convey his personal permission to re-open the school. A public elementary school can only be closed for a specified time: without action on the part of the sanitary authority to rescind their notice before the expiration of the specified period, the school cannot properly be re-opened. The action of the Medical Officer of Health is limited, in this matter, to advising his authority whether the circumstances of the case warrant the rescinding of the notice; or, on the expiration of the term for which the closure was ordered, whether the notice should be renewed or not. If the notice is not renewed, then school operations naturally re-commence.

No systematic official machinery of exclusion from school of children from infected houses, as distinct from closure of schools, appears to have been put in force by the Medical Officer of Health before he determined on closure. As a private practitioner, he personally forbade children from infected households attending school for periods averaging six weeks. And the same course was followed generally by private practitioners in the district. But no action under Article 7 of the Board's Memorandum was taken by the Medical Officer of Health. It is therefore difficult to determine whether in this case school closure would have been rendered unnecessary by "carefully considered measures of exclusion" carried out systematically. Probably, however, closure was rendered inevitable by the large number of notified cases, and the consequent numerous centres of infection in the district. The Medical Officer of Health appears, indeed, to have had ample grounds for securing the closure of the Byron Road Board School.

It becomes evident, from what has been stated above, that the Medical Officer of Health, in his very proper desire to prevent the spread of diphtheria through the agency of the Byron Road School, acted in an irregular manner. It is also apparent, from the attitude of the Gillingham and Grange School Board, that they failed to apprehend the methods of limiting attendance at school which are authorised under the Code. But on June 11th they took a step which indicates that they had begun to better appreciate their relations to Mr. Warren, for they appointed him, first at an annual salary, and later at a small fee per certificate, to grant certificates to parents of children who were unable to attend school by reason of sickness in their homes. On June 25th, they further instructed the head teachers to send children to Mr. Warren if they had reason to suppose that they came from houses where infectious disease was prevalent. This office of "Medical Officer to the School Board" lapsed, however, early in July, owing to Mr. Warren having resigned it.

App. A. No. 10.

On Diphtheria in Gillingham, in relation with School Attendance; by Dr. Sweeting.

It remains to add that, at a meeting of the Gillingham Urban District Council on July 2nd, attention was drawn to the need for sending all notices under Article 88 to Managers of Schools in writing. The Medical Officer of Health was also requested in future to make written reports to the Council giving his reasons whenever he considered it necessary to close any school.

It is, therefore, to be hoped that in the future the action of the Gillingham Urban District Council and of their Medical Officer of Health, in regard to the closure of elementary schools, or the exclusion from them of scholars from infected localities or houses, will be in strict accordance with the terms of the Education Code, under which alone any such action is intended to be taken, and under which alone it can be enforced.

August 1896.

No. 11.

APP. A. No. 11.

On Illness by Potted Meat at Mansfield: by Dr. Buchanan.

REPORT on an OUTBREAK of ILLNESS at MANSFIELD, caused by eating POTTED MEAT; by Dr. G. S. BUCHANAN; with Addenda by Dr. KLEIN, F.R.S., and Dr. CHATTAWAY.

In February 1896 the Medical Officer of Health of the Borough of Mansfield, Dr. Wills, reported to the Board the sudden occurrence in that town of a plurality of attacks of illness resembling "food poisoning," due, as he suspected, to consumption of certain samples of potted meat.

MAIN FEATURES of the OUTBREAK.

Having received instructions to make inquiry into the matter, I visited Mansfield, and, with the assistance of Dr. Wills, set about collecting facts with regard to all the cases of this illness which could be heard of. It will be convenient to state at once that although we heard rumours of several different articles of food—pork pies, brawn, sausages, "polonies," and the like—having caused the illness from which particular people suffered, yet detailed inquiry showed that every one of those attacked had consumed one article in common, a certain "potted meat"—a recently-prepared compound, to be distinguished from the class of potted meats sold in hermetically-sealed tins—made by a butcher in the town, to whom I will refer as Mr. X.

In response to a circular letter addressed to the several medical practitioners in Mansfield and the neighbourhood, these gentlemen very kindly supplied me with information as to persons in their practices who had been attacked. These persons, together with those of whom Dr. Wills and I heard from other sources, amounted in all to 265. Other cases no doubt occurred which did not come to our knowledge, but the number escaping recognition must needs have been comparatively insignificant.

Symptoms.

The history given by those attacked was of an illness characterised by gastro-enteric disturbance—diarrhœa, vomiting, and colic. Diarrhœa was the first sign of illness in most cases, and occurred during some part of the attack in almost all. It was profuse diarrhœa, and the motions were generally said to have been dark (sometimes they were described as black); almost always, it would appear, they were highly offensive. Vomiting was a frequent occurrence at the first onset of the illness, but had not often continued after the first two days of attack. Colic was, usually, severe, and patients who had profuse diarrhœa along with acute abdominal pain had, in some instances, become alarmingly collapsed.

These symptoms were accompanied by, and in a few instances appeared to have been preceded by, febrile and nervous disturbances. The fever was sometimes considerable. I was unable to procure a systematic record of temperature in any of the cases. But I heard of two adults in whom the illness began with a rigor and a temperature of over 104° F. in each case. And shivering, hot skin, restlessness, and other signs of fever were described by many sufferers. In those who had a moderately severe illness the fever lasted, as a rule, three or four days.

Nervous disturbance was indicated by intense headache (usually frontal), giddiness, and general muscular pains. Some of the medical men told me of cases where, the gastro-enteric symptoms not being conspicuous, the acute headache, general pains, and fever had given the

App. A. No. 11.

On Illness by Potted Meat at Mansfield; by Dr. Buchanan.

onset of the illness considerable similarity to that of influenza. Irregular nervous symptoms were reported in some instances. A woman of 50 said that she had suddenly been attacked by giddiness, followed by almost complete blindness for several hours. In two instances (neither accompanied by severe diarrhœa or collapse) a temporary loss of power in the limbs was reported. Giddiness, unsteady gait, involuntary and muscular twitchings and jerkings were heard of in a considerable proportion of the cases.

Excessive thirst was always spoken of, and the patients' tongues and mouths became very dry and parched. I saw two children with well-marked thrush, said to have come on after their illness. No skin eruptions were heard of. I noticed that several persons attacked had patches of recent herpes on their lips. No clinical observations as to the urine of patients were obtainable, but I was told of dark coloured and scanty urine by most of the sufferers. No cases of suppression of urine were heard of. I did not learn of any pulmonary complications.

Duration of Illness.

Some of the attacks had been mild, and had consisted merely of a gastro-enteric disturbance of one or two days' duration. But the majority of cases had been ill for a week or longer. The usual history was one of complete prostration, with some or all of the symptoms above, lasting three or four days, and then a slow recovery. Diarrhœa, in particular, had frequently continued (though less severely than at first) for a week or more after the general illness had abated. Headache, loss of appetite, and general weakness, were still complained of by many persons whom I saw two or three weeks after their attack. No deaths occurred among those attacked. The worst case heard of was that of a boy who was severely ill for several weeks, but ultimately recovered.*

Incubation Period.

The time which elapsed between eating the potted meat and the first sign of illness was inquired about in each case heard of. It could not always be determined, as in some instances the preparation had been eaten on more than one occasion, and in others the symptoms had been slight, and, in consequence, the facts about the illness had not received much attention. In 108 out of 218 cases in which a definite history was obtainable the first signs of illness had appeared between 18 and 24

* This boy, aged 14, had an unusually protracted illness. He was attacked after eating about 2 ozs. of the potted meat. His father, mother, and a sister of 12 years, had between them eaten 6 ozs. of the same potted meat at the same time. Each of the latter went through a moderately severe attack, while a baby who had received a morsel was also ill. Unlike the others, the boy had no diarrhœa, and had not vomited during the first few days of his illness. He seemed very ill from the first, wasted rapidly, was restless, sleepless, and feverish. In the second week he was slightly delirious at night. He complained of severe headache throughout. With Dr. Godfrey's concurrence, I saw this boy three weeks after his attack. I then noted that he was very weak and prostrate, with a general aspect like that of a typhoid fever patient in the second or third week. The nurse told me that his temperature for the last three days had varied from about 101° in the morning to about 103° at night. He was slightly delirious, muttering, drowsy, and stupid. Pulse 120, feeble and dicrotous. Fauces injected. Tongue dry and brown. Sordes on lips. Respiration, 30; a little cough. No rash. Abdomen somewhat tender; spleen just felt. Said to have slight diarrhœa, with motions which are natural in colour, but offensive. Urine scanty. Boy complains of abdominal pains and bad frontal headache. I learn that he gradually improved after the fourth week, without further complication.

hours after eating the potted meat. Other 64 persons had been attacked between 12 and 18 hours, nine in less than 12 hours, while in the remaining 37 no illness had appeared for more than 24 hours after partaking of it. The longest period of latency was 48 hours, and the shortest was five hours. In one instance a woman vomited immediately after she had eaten the potted meat, and escaped further illness.

It did not appear that the amount of potted meat consumed in each instance had any definite relation to the length of the interval between swallowing the food and the onset of symptoms of illness.

The Cause of the Outbreak.

As has been said, the mischief was in each instance traceable to potted meat made by Mr. X. Particular illustration is afforded by facts as follows:—

(1.) In not a few households all those who had eaten potted meat were attacked, whereas all who had not eaten escaped.

(2.) Certain persons attacked in households into which potted meat had not been introduced were found in each instance to have consumed the preparation when on a visit.

(3.) In each of those places near Mansfield where the potted meat had been distributed—Bolsover and Hill Town, Pleasley Vale, Warsop,* and elsewhere—illness occurred only among those who consumed it.

And the virulence of the substance was remarkable. To give one instance, 4 lbs. of the potted meat, retailed from a small shop in Hill Town, caused illness in each of the 21 persons who had eaten it. Indeed, of a total of 279 persons who were ascertained to have eaten the potted meat, not more than 14 could be said to have escaped illness.

Distribution of the Implicated Potted Meat.

The potted meat in question was made on Mr. X.'s premises on February 11th, and it was on sale at his shop in Mansfield from February 12th to 14th. A small quantity was also sold on these days from a second shop which Mr. X. keeps in another part of Mansfield.

On February 12th and 13th, this substance, along with other preparations—chiefly pork-pies, "polonies," and sausages—was taken by Mr. X.'s traveller to five retail shops in Mansfield. Three of these are co-operative stores, while two are kept by small general dealers. The three co-operative stores received a further supply of the same potted meat on February 14th. The total quantity supplied to all these retail shops in Mansfield in these three days was 49½ lbs., nearly all of which had been sold out by February 15th. On February 12th the traveller took other 8 lbs. to co-operative stores in Pleasley Vale, five miles out of Mansfield, and on the 13th he supplied 10 lbs. to certain shops in Bolsover and Hill Town, nine miles away. On Thursday, 13th, Mansfield market day, 10 lbs. were bought at Mr. X.'s shop by a shopkeeper at Warsop, and retailed from stores in that village. The potted meat was also sold at the Mansfield shop to some of the country people marketing on that day.

By February 15th Mr. X.'s traveller had heard that the preparation was supposed to be causing illness. Accordingly, when he went on his

---

* These places are comprised in the urban districts of Bolsover, Mansfield Wodehouse, and Warsop respectively.

rounds on that day and on the 17th, he inquired at the several shops for any potted meat yet unsold. He was, however, able to collect a few pounds only, and this Mr. X. disposed of in his "blood tubs," the contents of which were subsequently taken away by a farmer for manure.

Meanwhile, potted meat had again been made on Mr. X.'s premises on February 14th, and on the next day this new supply was distributed to certain retail shops as before. A shop at Wodehouse had received none of the February 11th potted meat, but was now supplied with this fresh preparation. No one who consumed this potted meat at Wodehouse was affected. Similar freedom from illness was heard of among persons who had bought potted meat (presumably that of February 14th) at Mr. X.'s shop in Mansfield on February 15th or later. Purchasers of potted meat on February 15th, at the retail shops from which the February 11th preparation had been removed and the fresh supply substituted, remained equally free from illness. A seeming exception occurred, however, at the Littleworth Co-operative Stores, in Mansfield, where potted meat bought on February 15th (after the new supply had, for the first time, been delivered on that day) proved just as virulent as before.

But Mr. X.'s traveller told me that the fresh supply distributed by him on February 15th had been taken indiscriminately from tins on Mr. X.'s premises, the traveller himself having no means of knowing whether the contents of any particular tin had been made on February 11th or on February 14th. I ascertained subsequently that certain tins of February 11th potted meat were still on Mr. X.'s premises on February 15th, and Mr. X. could not account for their disposal unless they had been carried out by the traveller on that day. Hence it seemed likely that at the Littleworth Stores it was really potted meat of February 11th which was delivered on February 15th as a fresh supply, and that the seeming exception was, in fact, no exception at all.

None of the retail shopkeepers nor any of the customers had noticed anything that they regarded as objectionable about the appearance of the potted meat. Most, however, had had their attention attracted by its red colour, as Mr. X.'s potted meat, they said, was not usually red. As to taste, some persons had considered it exceptionally nice, others thought it much as usual, while others, again, had noticed it to be "tasteless" or "mawkish" or to "taste of copper." It had not smelt objectionably.

Samples of the meat were hard to obtain. Those procured and sent to Dr. Klein were:—

1. A specimen (which had been bought on February 13th) obtained by Dr. Wills, on February 20th, from a house in Mansfield in which persons had been attacked.
2. Specimens obtained from the Littleworth Co-operative Stores on February 24th: (A.) A portion of February 11th potted meat, part of a supply consumed by, and causing illness in, the family of the manager of the stores. (B.) A portion of the potted meat supplied to the same stores on February 15th, to which I have above referred. This specimen was less red than specimen (A.).

These Littleworth samples were the only specimens that could be heard of at the time of my visit. Both had been thrown the day before into a dry ash heap. Portion A. was found completely wrapped up in thick paper, but portion B. was cut out of the centre of a mass of potted meat which was lying among some dry cinders.

Manufacture of the Implicated Potted Meat.

Mr. X.'s statement with regard to the manufacture of the material was to this effect :—Potted meat is usually made by him at the beginning of the week from the pieces of beef in his shop which have not been sold during the previous week. Usually he adds to the beef a small quantity of pork. Two bullocks were killed at his slaughter-house on February 4th. Both were fat beasts and in good condition. He sold beef from these carcases up to Monday, the 10th. On the 11th he took some of this beef that was unsold—pieces of brisket and neck hanging up in his shop, and other pieces set aside on the dresser—and gave them to his assistant, Y., to make into potted meat. Mr. X. described these portions of beef as having presented in every way a good appearance. At the same time he gave Y. the hocks of two pigs to be added to the beef. These two pigs belonged to a litter of four, all slaughtered on his premises the previous day (February 10th). Y., according to custom, was to boil the beef and pork, free the cooked product from bone, mince it, add pepper and salt, and put it with a little gravy, into certain shallow, large and small, tins usually employed for the purpose. Mr. X. had not witnessed the making of this particular compound, but told me that Y. has made potted meat under his supervision for several years, always making it in this manner. All the meat used in the preparation, Mr. X. asserted, came from his shop as above described. No scraps of meat had been added from elsewhere. Only meat, pepper, and salt, and, occasionally, red colouring matter, were ever employed on his premises in the manufacture of potted meat. Neither the beef used nor the potted meat made on this occasion had been weighed, but Mr. X. estimated that about 1 cwt. of potted meat had been manufactured. And, judging from the amount of potted meat recorded in Mr. X.'s books as having been supplied to retail dealers, and from the quantity which Dr. Wills and I ascertained to have been bought at Mr. X.'s shop, it seemed that at least 1 cwt. had been sold.

Now this quantity represented, of course, still more than 1 cwt. of uncooked meat with bone. The hocks of the pigs already referred to would, at Mr. X.'s maximum computation, have weighed 40 lbs. Taking the uncooked meat as 1 cwt. only, there remain, therefore, at least 72 lbs. which, according to Mr. X., consisted of beef from his shop.

Mr. X. sold the potted meat to retail tradesmen at 5*d.* a lb. He makes potted meat nearly every week in considerable quantity, and finds its manufacture profitable.

Y. confirmed Mr. X.'s statements. The beef and pork, were, he said, taken by him into the preparing room. There he put them into a large iron boiler, poured in water (obtained from the public supply), lit the fire beneath, and left the compound to stew from between eleven and twelve in the forenoon to five o'clock in the afternoon. Whether the water actually boiled or not he was unable to say.* At the end of that time Y. removed the meat from the boiler to a large tin bucket. At the same time he ladled some of the gravy from the boiler into a jug, and took it to Mrs. X. to be added to pork pies.

He next turned the meat in the bucket out on to a chopping board, freed it from bone with his hands and knife, and then put it, portion by portion, through a revolving mincing machine, adding pepper, salt, and

---

* At my request the boiler was filled with water, and a fire lighted. In less than an hour the water was boiling briskly.

some "Indian red" at the same time. As the meat was minced it was replaced in the bucket. When the mincing was finished the contents of the bucket were divided among several shallow open tins, a little gravy being ladled from the boiler into each tin, in order to give consistency to the potted meat and make it set. The tins, as prepared, were placed on the dresser in the preparing room, and later in the evening were all put on a shelf in the salting room adjoining. It was from this shelf that Mr. X.'s traveller took the meat on the next and subsequent mornings, turning out the contents of each tin as required, and wrapping them in paper.

Certain points in connexion with the manufacture thus described require to be noticed.

The preparing room is habitually used as the pig slaughter-house of the establishment. On February 10th, the day before the potted meat was made, four pigs had been slaughtered here—two of the four furnished the hocks added to the preparation. Various pieces of meat from these pigs were used to make brawn on February 11th. The brawn was made in a boiler standing by the side of that used for making potted meat, and both boilers were heated at the same time. On the same day certain other portions of these pigs were made into sausages. Other parts, again, were put into brine tubs for salting.

When I first visited Mr. X. I found that two pigs had just been slaughtered in the preparing room. The carcase of one was suspended with its head in one of the boilers, and was there being scraped. Among other utensils then being used in dressing these carcases was the bowl subsequently pointed out to me as having been employed to ladle the gravy of the potted meat. Indeed, it seemed that the workers in this room had no exact rule for the employment of particular utensils for particular purposes; those in which raw meat and sausage meat were kept and made up, for instance, appeared to be used at other times for cooked brawn and potted meat, and *vice versâ*. The flat tins into which potted meat is placed when made were shown to me. Some of these tins had been very indifferently cleaned.

The preparing room is distinct from Mr. X.'s shop and dwelling-house. It is a long brick shed, lighted at the top and on one of its sides. The paving, made of stone flags, slopes towards the door. The waste waters of the slaughtering and dressing run beneath the door to a gutter outside, which conveys these liquids along an open yard to a trapped gully, and so to the sewer. There is no drain opening within the room itself. The mincing machine (which was fairly clean when I saw it) stands in one corner of the room. Alongside it is the sausage machine, and then comes a dresser used for preparing meat. On the opposite side of the room are the iron boilers already mentioned. Each is bricked round, and has its own furnace beneath. At the far end of the room is a pen for keeping pigs until they are slaughtered.

The salting room leads out of the preparing room. Both preparing room and salting room buildings are old, and on one side they face a house now unoccupied and ruinous. Between these rooms and the ruined house is a passage two or three feet wide, filled with old rubbish and débris. No refuse, I ascertained, had recently been put into this passage, which is, indeed, difficult to get at, and leads nowhere.

As to the Source of the Deleterious Agent in the Potted Meat.

The potted meat had clearly become capable of causing illness while it was on Mr. X.'s premises. And apparently this had taken place

after the cooking. The bullocks, which, according to Mr. X.'s account, had supplied all the beef in the potted meat, had been sold to Mr. X. in the cattle market by a dealer, who had just bought them, I was told, in order to re-sell. I could not find this dealer, and thus was unable to trace the previous history of the bullocks. But on February 10th, and for a week prior to that date, beef from these two carcases had been sold to various persons. I could learn of no ill effects among those who had eaten it. The pigs which supplied the hocks which were added to the preparation afforded material for the brawn made at the same time, and also, later in the week, for pork pies. Both brawn and pork pies had been extensively sold, but had done no harm.

That the deleterious agent was introduced into the potted meat after it had been cooked is further indicated by the fact that the gravy obtained from the cooking of the beef and pork was straightway added to pork pies; these pies being subsequently eaten by many persons, always with impunity.

It thus became necessary to seek for a deleterious agent super-added to the potted meat somewhere in the interval between the time when the cooking was completed on February 11th, and the time when meat was first turned out of the shallow tins in the salting room on the following day. But I could not determine at what stage of this interval such addition occurred, or in what way it had taken place. Attention was first directed to the shallow tins in which the potted meat had been stored. Did these tins already contain the deleterious agent when the potted meat was put into them? If this had been so, this agent must needs have been already present in each of several separate tins before the potted meat was added. For the contents of every one of the tins had been poisonous. But although, as I have said, certain empty potted meat tins shown to me appeared to be kept in an uncleanly condition, I could obtain no indication of a general contamination of all the tins which had been used on this occasion. Next, had these several tins been contaminated after the potted meat had been put in them? All the tins, as soon as filled, lay for a time on the dresser in the preparing room. I had no information in any way suggesting that a deleterious agent had there gained access to them. And the brawn and other materials standing on the dresser at the same time did not prove deleterious.

The tins had next been taken from the preparing room to the shelf in the salting room adjoining. Over the salting room is a loft in which sawdust is stored. An aperture in the wall above the shelf opens to a staircase leading to the loft, and through this aperture sawdust or other matters taken up or down the staircase might easily have been scattered over the tins of potted meat on the shelf. But I could not learn of any newly obtained sawdust or of other dusty material that had been taken up or down the staircase about February 11th. Moreover, if contamination had occurred in the salting room, it was to be expected that the brawn made at the same time and placed on the same shelf would also have become poisonous.

It seemed, therefore, more probable that it was in the course of the mincing and making up that the contamination took place. I obtained, however, no facts which led to the inference that Y.'s hands and knife, which were used freely in this process, were unclean, or that the mincing machine was dirty. Y. himself was in good health at the time.

As regards the materials stated to have been added to the potted meat, no suspicion attached to the pepper and salt, which had been used

App. A. No. 11.

On Illness by Potted Meat at Mansfield; by Dr. Buchanan.

to season sundry other preparations. No mineral powder or other chemical substance appeared to have been added besides the "Indian red."* This pigment had undoubtedly been employed in unusually large quantity—for what reason I could not determine—but there were no indications that, *per se*, it had been harmful. A fresh tin of "Indian red" had been obtained by Mr. X. about a month before. Pigment from this tin had been added on more than one occasion to brawn, including the brawn made on February 11th, and no ill effects were traceable to its presence there.

No new utensils had been employed in the manufacturing process, and the various receptacles in which the potted meat was prepared were made either of iron, enamelled iron, or "tin." Concerning the condition of cleanliness, or the reverse, of these receptacles and utensils, at the time of preparation of the potted meat, I could obtain no information. I have already noted that some of those shown to Dr. Wills and myself were imperfectly cleaned, and that certain utensils appeared to be employed indifferently for the diverse operations carried on in the preparing room.

It is possible, of course, that in the making up of this potted meat there had been circumstances or conditions other than those of which I had information from Mr. X. or from his assistant. In view of this consideration I endeavoured to ascertain how the large amount of material resulting from the slaughtering and dressing of four pigs in the preparing room on February 10th had been disposed of or was being dealt with when the potted meat was made on February 11th. Some of it had been used for salting, and other parts were employed in sausage making, brawn making, and other processes—all of which were, I learnt, carried out in the preparing room on February 11th—and in addition there must needs have been a considerable quantity of remnants of various kinds from these carcases which had to be disposed of. But I could not trace such remnants to the potted meat, nor indeed any other extraneous matter, and this question, therefore, I had to leave unsolved.

As to the Nature and Method of Operation of the Deleterious Agent.

As has been said, there was no indication that the potted meat had contained a mineral poison. And the diversity of the malady as it affected different persons, both as regards the symptoms exhibited and the severity of the illness produced, was not altogether consistent with the operation of such poison. Further, when the histories of all the cases were compared together, there did not appear to have been any general correspondence between the character and gravity of the disease produced, on the one hand, and the quantity of potted meat that had been consumed on the other. In the majority of cases, too, the time

* Mr. X. stated positively that no chemical ingredients are used on his premises besides the "Indian red" and another red pigment, used exclusively for colouring "polonies." Evidence was conflicting as to the use of this "Indian red" in the preparation of Mr. X.'s potted meat. Mr. X. told me that "Indian red" was not usually employed by him for this purpose, and that before hearing of the outbreak of illness he had remonstrated with Y. for having coloured the February 11th preparation. Y., on the other hand, states that it is his custom to add some colouring to all potted meat, and that on this occasion he had merely put in a larger quantity than usual. I procured a sample of this "Indian red" for analysis. Dr. Chattaway's report on this substance is appended. It contained no mineral poison.

which had elapsed between swallowing the meat and the onset of illness could not be reconciled with the operation of any mineral poison.

The circumstances of the outbreak, as regards character and duration of illness, absence of correspondence between gravity of attack and magnitude of dose, and the various periods of latency in those attacked, were all, however, to be accounted for if the malady had resulted from the life processes of a living organism in the potted meat. Moreover, among outbreaks of meat poisoning, which in each instance have been referred to the presence of microbes in the inculpated meat, some have in almost every particular presented a close resemblance to this Mansfield outbreak.

It seems desirable, therefore, to consider this outbreak from the point of view that it was by the agency of micro-organic life that the material was primarily rendered infective.

In his summary of a collection of cases of meat poisoning,* Dr. Ballard distinguishes—(1.) Those caused by the introduction of a harmful microbe into the body. (2.) Those caused by the introduction into the body of a poison which has already been manufactured in the meat by such microbe. (3.) Those in which both microbe and its already manufactured poison have been together concerned in the illness. The distinction between the three classes is chiefly one of duration of the incubation period, which, as a rule, in the first class is long, in the second is short, and in the third is variable in the different persons attacked. Besides shortness of incubation of the induced illness, poisoning by already manufactured product is characterised (like other chemical poisons) by producing in each of the individuals who consume it an illness the severity of which is roughly proportional to the amount of poison consumed.

In this outbreak there were several examples of a long incubation—36 to 48 hours—before any symptoms of illness appeared. In these instances it may well have been that a poisonous substance was manufactured within the body, after the meat had been eaten, by microbes contained in the meat. On the other hand, there were certain cases with a short incubation; nine persons were attacked within 12 hours of eating the potted meat, the shortest intervals being five hours in one person, and six hours in three others. In these cases a poisonous product already manufactured within the meat was probably the cause of the first symptoms. In a few households a short period of incubation was reported for each of the inmates attacked. In some of these households Dr. Wills and I found that the severity of attack in each person was said to have corresponded with the amount of potted meat he or she had eaten. This condition of correspondence of attack with dose was not met with in certain other households, in which the majority of those attacked were reported to have had a prolonged incubation period. In most households, however, exact information as to relation of attack to dose was not to be had; we usually found, indeed, that quite a small quantity of potted meat had been sufficient to cause serious illness. In view of this fact, and of the small number of the cases in which symptoms appeared in less than 12 hours, I am disposed to infer that few out of those attacked owed their illness directly to poisonous substances already present in the potted meat when swallowed.

On tabulating 218 cases in which Dr. Wills or I had been able to obtain information as to the period of incubation, it appeared that, taken broadly, those persons who ate the potted meat soonest after its

* Report of the Medical Officer of the Local Government Board for 1890, p. 200.

manufacture had a shorter period of incubation; while those who ate this preparation on later days had a longer incubation period. Thus :—

Periods of Incubation.

—	5–12 hrs.	12–18 hrs.	18–24 hrs.	24–36 hrs.	Total.
Number of persons eating potted meat—					
On Feb. 12 -	4	18	16	—	38
„ 13 -	3	20	27	9	59
„ 14 -	2	24	40	18	84
„ 15 -	—	2	25	10	37
	9	64	108	37	218

Several possible occurrences may be thought of as explaining the increase, from day to day, in length of incubation period indicated in this table. Those who ate the meat on February 12th might, perhaps, have been consuming an already manufactured chemical poison, which, being unstable, gradually disappeared from the preparation as time went on. Or, setting aside (for reasons already indicated) the question of superadded chemical poison, it may be supposed that the hypothetical microbe capable of causing the mischief was, on February 11th, in a condition in which it could rapidly develop its products in the alimentary canal, or was present in the potted meat in maximum quantity on that day; while on the later days it had so far diminished in virulence or in quantity as to require a longer time to elaborate these products. Such an effect upon the infecting microbe might be due merely to such physical conditions as exposure to air and to changes of temperature; or, on the other hand, it might have resulted from chemical changes, which rendered the meat from day to day less suitable as a multiplying ground for this particular microbe. It will be seen from Dr. Klein's report that he found microbes in an altogether "unusual and remarkable" number in each specimen of the potted meat he examined, the most abundant form being *proteus vulgaris* and *bacillus coli*.

Now either of these abundant micro-organisms, finding in the potted meat a suitable pabulum, and there multiplying, must needs have thereby influenced, favourably or adversely, the infecting microbe by hypothesis also present in the meat. Seeing that the dominant organisms found by Dr. Klein are capable of producing very different chemical substances (bacillus coli, for instance, habitually forming acid, and bacillus proteus alkaline products), and that their multiplying ground, the potted meat, itself consisted of a medley of material, it is quite likely that the hypothetical infecting microbe was, as time went on, now fostered, now inhibited, as a result of some of the chemical changes effected in the meat by bacterial action.

In certain outbreaks of meat poisoning which are comparable to the present occurrence at Mansfield, it has been possible to detect in the inculpated meat a microbe which possessed infective properties, and to refer the particular outbreak to the presence of this micro-organism. Such an instance was furnished by the Welbeck ham poisoning case, and by others recorded by Dr. Ballard in his summary.* It will be

* See also Polin et Labit "Étude sur les empoissonements alimentaires :" Octave Doin. Paris, 1890.

seen from Dr. Klein's report that although a large number of microbes of different sorts existed in each specimen of the Mansfield potted meat sent to him, no organism which can in this sense be considered to possess specifically infective properties was detected among them.*

But, as has been said, Dr. Klein has found that bacillus proteus and bacillus coli were present in the potted meat in an altogether unusual and remarkable number. And he points out that both of these common microbes decompose albuminous substances into poisonous products, and that either might, under exceptional conditions, itself manufacture such products within the human body in such a way as to cause symptoms of poisoning. He indicates that such exceptional conditions may be fulfilled in a disturbance of digestive function, and that this potted meat may very well have caused a disturbance of this kind––either because the simultaneous introduction of the "Indian red," which proved to be strongly alkaline, was sufficient to neutralise the gastric juice, or because there was introduced with the potted meat a quantity of already manufactured bye-products of the numerous microbes detected in the preparation––bye-products, perhaps, sufficient of themselves to derange digestion in the human stomach.

ADDENDUM A.

Report by Dr. Klein, F.R.S.

I. Upon a Specimen of Potted Meat received on February 22nd, 1896. Obtained and sent by Dr. Wills, as a Sample of Potted Meat made by Mr. X. on February 11th.

This potted meat was of a red colour, and had a natural appearance to the unaided eye. It had no offensive smell. Examined microscopically it was found to contain micro-organisms in abundance. There were numerous bacilli of various sizes, and cocci, both in the form of diplococci and in chains.

In order to isolate the several species of microbes present, cultivations of the meat were made in gelatine and agar plates. Each plate was inoculated with a trace of the potted meat taken up with the loop of a platinum needle. In every one of the gelatine and agar plates the number of colonies which developed was so large that it was impossible to count them.

By subculture from these plates I isolated the following species of microbes:—

(1.) *Staphylococcus albus non-liquescens.*—A variety growing scantily on gelatine, but multiplying rapidly on agar at 37° C.

(2.) A motile bacillus rapidly liquefying gelatine which corresponded in all respects with *proteus vulgaris.* This was the species present in greatest abundance both in the gelatine and in the agar plates.

(3.) *Bacillus coli.*—Comparatively few colonies.

This sample of meat was given as food to mice, four of which animals were fed upon it for two successive days. No ill effect was produced in them.

II. Upon Specimens received from Dr. Buchanan on February 26th.

These consisted of—

Sample of potted meat A.—Potted meat manufactured on February 11th by Mr. X.

---

* Dr. Klein received the first sample 11 days, and the second samples 15 days, after the potted meat had been manufactured.

Sample of potted meat B.—Potted meat which caused illness, but which, on the ground of its paler colour, was suspected to have had an origin different from that of sample A.

Bottle containing "Indian red" colouring matter, used in the preparation of Mr. X.'s potted meat of February 11th.

A portion of this pigment was submitted to Dr. Chattaway for analysis. His report is subjoined.

Sample A., when examined microscopically, showed an enormous number of microbes, bacilli of different sizes, cocci, yeast cells, and a few spores.

Cultivations from this specimen were made in gelatine and agar plates as before. The colonies developed in as great an abundance as in the specimen sent by Dr. Wills.

By subculture from the plates I obtained the following species of microbes:—

(*a.*) *Typical proteus vulgaris.*—This was the species present in greatest abundance in the plates.

(*b.*) A variety of *proteus vulgaris*, liquefying gelatine with less rapidity than typical proteus, and forming more voluminous flocculi in the liquefied medium. This species was also abundant in the plates.

(*c.*) *Proteus Zenkeri.*—A few colonies.

(*d.*) *Bacillus coli.*—A large number of colonies.

(*e.*) *Staphylococcus albus non-liquescens.*—A few colonies.

(*f.*) *Staphylococcus albus liquescens.*—A few colonies.

(*g.*) A few colonies of *moulds.*

Sample B.—The surface of this sample was covered with mould. On cutting into it numerous red spots of pigment were seen, although the pigment was present in less quantity than in sample A.

A particle of the meat taken from the centre of the sample showed a large number of microbes; bacilli of various sizes, cocci, mycelial threads, and spores of moulds.

Cultivations from this specimen were made in gelatine and agar plates as before. The colonies developed in as great abundance as in the previous specimens.

By subculture I obtained the following species:—

(1.) Typical *proteus vulgaris*, the colonies of this species predominating in number as before.

(2.) *Proteus vulgaris* of variety (*b.*) above.

(3.) *Proteus Zenkeri.*—Numerous colonies.

(4.) *Bacillus coli.*—A large number of colonies.

(5.) *Staphylococcus albus liquescens* and *non-liquescens.*

(6.) Numerous colonies of *moulds.*

With portions of sample A. four mice were fed, and four other mice were given sample B. as food. The animals consumed a considerable amount of each sample. No ill effects resulted in any of them. Two mice were fed on bread and milk to which the "Indian red" colouring matter had been added in large quantity. Both remained well.

The virulence of each of the species of proteus above distinguished as (*a.*) and (*b.*) was separately tested. Thus 1 c.c. of a broth culture of proteus (*a.*), incubated at 37° C. for 48 hours, and already crowded with microbes, was injected subcutaneously into the groin of each of a series of four guinea-pigs; 24 hours after the injection each animal presented an extensive œdematous swelling in the groin, abdomen, and chest. All the animals were quiet, and did not feed. Death occurred in 48 hours. Post mortem it was found that in each instance the subcutaneous tissue of the groin, the abdomen, and chest was much swollen by malodorous blood-stained fluid. The muscular tissue beneath was gangrenous; the intestines were injected, relaxed, and contained a blood-stained mucus; the spleen was dark and slightly enlarged. The fluid in the subcutaneous

tissue was full of b. proteus, and the organism was also found in large numbers in the spleen.

These results are comparable to those usually produced when broth cultures of ordinary specimens of proteus vulgaris—such as occur, for example, in putrid meat—are tested by inoculation into guinea pigs. It may be noted, however, that in order to produce results such as those just described, the broth culture of an ordinary specimen of proteus would have to be injected in a quantity somewhat larger than the 1 c.c. used in this instance. Wherefore the particular proteus (*a.*) was, if anything, more virulent than usual to this test.

Broth cultures of proteus (*b.*) were made and tested in the same way. Each of the four guinea-pigs which were injected subcutaneously in the groin with 1 c.c. of this culture, presented at the end of 24 hours the same appearance of œdema and other signs of illness as those injected with proteus (*a.*). At the end of 48 hours, however, these guinea-pigs were a little better, and in 72 hours all were distinctly better and recovering.

In order to determine whether the admixture of the colouring matter had any effect upon the microbes, I added some of the "Indian red" to broth and to gelatine in a quantity sufficient to stain these culture media a deep red. I then sterilised the media and employed them for the growth of the following organsims isolated from the potted meat:—

Proteus (*a.*), incubated on the coloured gelatine at 20° C., grew copiously and in a normal manner. The colouring matter became paler. Proteus (*b.*), treated in the same manner, behaved similarly, and produced a like result in decolorising the gelatine.

A coloured broth culture of each of these organisms, incubated at 37° C., was used in each instance to inoculate guinea-pigs in the manner above described. No difference was found to exist in either instance between the virulence of the coloured broth culture of the organism and the virulence of uncoloured broth cultures of the microbes.

Proteus Zenkeri, incubated on the coloured gelatine at 20° C., showed only a scanty growth. It did not affect the colour of the gelatine.

Bacillus coli, incubated in the same way, also showed scanty growth, and did not affect the colour of the gelatine.

Staphylococcus albus non-liquescens (from sample A. of February 22nd) was grown both in ordinary and in coloured broth. In the latter medium the growth was very feeble. In the former it was abundant. The uncoloured broth culture, however, was harmless to guinea-pigs when injected subcutaneously in doses of 1 c.c.

Observations.

Judging from the large number of colonies which developed from the inoculation of culture media with a mere trace of meat from each of the specimens, it seems that microbes were present in this potted meat in an altogether unusual and remarkable quantity. The organisms isolated are of a kind commonly associated with the decomposition of albuminous substances. One of them, bacillus proteus, although essentially a saprophyte, produces, by its action upon albuminous matter, substances which are poisonous to man. Another, bacillus coli, is also capable of producing poisonous alkaloids. Now food in which slight decomposition has been set up by proteus is not unfrequently harmless to its consumer. But such food can very rarely contain the microbe in such an abundance as was found in each of these samples of potted meat. And when incipiently decomposed food of this sort is eaten with impunity there is reason to believe that the proteus bacilli (which require an alkaline medium for their rapid multiplication) are destroyed, on reaching the stomach, by the action of the acid gastric juice.

Now in this case Dr. Chattaway reports that the "Indian red" colouring matter, present in large quantities in the preparation, contained no less than 90 per cent. of sodium bicarbonate. Thus, accompanying the large number of proteus bacilli in the potted meat, there was also present an alkali which would neutralise the gastric juice. Moreover, the large number of other microbes—such as bacillus coli—present in the potted meat

App. A. No. 11.

On Illness by Potted Meat at Mansfield; by Dr. Buchanan.

would have already manufactured therein products which were likely to interfere with the digestive processes of the stomach. For these reasons it is probable that if potted meat of the kind I received were consumed, the proteus bacilli would neither be destroyed by digestion nor have their growth inhibited by gastric juice. They would pass in large numbers into the duodenum and small intestines. Here everything would favour their growth and the rapid development of their poisonous products. They would then reach an alkaline medium, and would rapidly multiply at the body temperature. It may be remembered that a broth culture of bacillus proteus, incubated at 37° C., will become thick with microbes in as short a time as 12 hours.

In connexion with the harmlessness of the potted meat when given as food to mice, it should be remembered that mice and other rodents are not susceptible to poisoning by the ingestion of putrid materials, and this immunity does not, therefore, indicate a corresponding harmlessness to the human consumer.

ADDENDUM B.

Report by Dr. Chattaway, D.Sc., Ph.D., on a Sample of Red Colouring Matter labelled "Indian Red."

The sample of colouring matter supplied is a soft crimson powder readily soluble in water, giving a deep red solution which dies wool a bright red colour.

This colouring matter is found to be entirely free from arsenic and all other mineral poisons, and to contain no iron.

Its general properties and freedom from iron show that it actually contains no "Indian red," which is a naturally occurring earthy substance, very rich in ferric oxide, and much used as an insoluble and permanent deep red pigment.

The substance is found to consist of a deep red colouring matter mixed with about 90 per cent. of sodium bicarbonate and a little salt, these latter being added probably to cheapen the product, and to bring out the colour more obviously.

The colouring matter itself belongs to the class of azo-colours, a series of compounds derived from coal tar, and containing one or more of the diatomic groups — N = N — linking together acid or basic aromatic radicles. Some of these compounds are of great technical value, and are manufactured in large quantities owing to their importance as dye stuffs.

This colour is an acid azo-red containing sulphonic groups, and probably obtained from derivatives of naphthaline. Such colours are not usually considered poisonous, but their physiological action has not, so far as I am aware, been investigated.

It seems probable that the mixture is a red organic colouring matter such as is sold for the purpose of tinting food stuffs, *e.g.*, sweets, jellies, &c., and may have been supplied in mistake for the "Indian red" (either native or an artificial imitation, consisting of ferric oxide) usually mixed with the potted meat to render it of more attractive appearance.

Chemical Laboratory,
St. Bartholomew's Hospital,
March 6, 1896.

App. A. No. 12.

On Cases of Illness, suspected to be Bubonic Plague, in the Port of London; by Dr. Buchanan.

No. 12.

Report upon Cases of Illness, suspected to be Bubonic Plague, occurring in the Port of London; by Dr. G. S. Buchanan.

In October 1896, the Board were informed by Dr. Collingridge, Medical Officer of Health of the Port of London, of the occurrence in one of the docks in London of a case of fatal illness which was suspected to have been bubonic plague.

The death in question was that of a Portuguese native of Goa, to whom I will refer as A. P., a "knifeman" on board the steamship "A," which had arrived at the dock from Bombay on September 11th. A. P. had been admitted to the Branch Seamen's Hospital on September 29th, and had died there on October 3rd. Particular importance was attached to the case, in view of the fact that in October plague was known to be present in Bombay.

Dr. Collingridge had also learnt that on September 19th a man, M. M., a seedie-boy employed as fireman on board another steamship, "B," which had arrived at the same dock from Calcutta on September 7th, had been taken, in consequence of illness in which fever was associated with enlarged glands in the groin, to the Branch Seamen's Hospital, where he had died within a few hours of admission. Such few facts as were to be had with regard to this seedie-boy's illness were, in view of the case of A. P., thought to be not inconsistent with a belief that he also had suffered from bubonic plague.

The Board decided that inquiry into these cases should be made by one of their Medical Inspectors, and on October 29th I received instructions for this duty. I conferred with Dr. Collingridge, and visited the dock in question, the Branch Seamen's Hospital and other sanitary offices and places in connexion with the subject of my inquiry. I also paid several visits to officials of the Company owning the vessels, who were good enough to render me every assistance.

Of the two cases reported by Dr. Collingridge, a history which permits of a definite conclusion as to the nature of the illness was to be had only for the Goanese "knifeman," A. P., of the steamship "A." I will, therefore, deal first with his case.

The steam-ship "A" had sailed on her return voyage to India more than a fortnight before my visit to the dock. The history of her last homeward voyage had been briefly as follows:—

The vessel had left Bombay (where she had remained for some weeks) on August 21st; she reached Aden (where she stayed five hours) on August 26th; Suez (stay of eighteen hours) on August 30th; Brindisi (stay of three hours) on September 3rd; Malta (stay of six hours) on September 4th; Gibraltar (stay of two hours) on September 7th; Plymouth (stay of one hour) on September 10th; and London on September 11th.

She carried a crew of 199 hands; 119 passengers; and a general cargo. The members of the native crew, which consisted of 40 lascars, 61 Africans, and 24 Portuguese, had been shipped at Bombay on August 20th.

Clinical History of A. P.—This man, whose age was believed to be 17, was a Goanese "knifeman"—that is, a steward's helper. He had joined the steam-ship "A," with other native crew, at Bombay on August 20th, 1896. No history was to be had of any illness from which he had suffered prior to his joining, with the exception of information

App. A. No. 12.

On Cases of Illness, suspected to be Bubonic Plague, in the Port of London; by Dr. Buchanan.

from the Company's dock superintendent (who had it through the surgeon of the steam-ship "A" by way of the interpreter) that A. P. was believed to have been in Calcutta on a previous voyage, earlier in 1896, and to have been there treated in hospital for syphilis. It appeared from the medical reports of the steamship "A" that no evidence of syphilis or other disease had been found when A. P. joined the vessel on August 20th, nor was he, according to these reports, at any time taken off duty or known to have ben ill during the voyage from Bombay to London.

I found some difficulty in learning about A. P. between September 11th, the date of the arrival of the steamship "A" in dock, and September 29th, the date of his admission to hospital. Medical inspection of the crews of other vessels belonging to the Company lying in the same dock is made daily. It is customarily performed by mutual arrangement between the surgeons of the several ships in dock, one or two ship surgeons undertaking the duty of visiting all the vessels on a given day. The returns of sick crew treated on board in the dock, made by the surgeon or surgeons of the day, although showing the daily number of sick on each vessel, did not give names or other means of identifying particular sick persons, or the illness from which they suffered.* I was, however, informed by the interpreter that A. P. had stated that he had been ill for three or four days before September 29th. On each of the three days prior to this date the steamship "A" had, I found, been visited by a different surgeon. The surgeons in question had gone foreign at the time of my inquiry, but the Company has been good enough to place me in communication with certain of them. The surgeon who visited the steamship "A" on September 27th writes that on that day he attended on that vessel a Portuguese "knifeman" who was "suffering from an attack resembling ague, and who stated that he "had previously suffered from attacks of fever." He is unable to say whether or no this was A. P.

The surgeon who saw A. P. on September 29th wrote that he had a distinct remembrance of the case. He found the man lying in a bunk, "nearly unconscious, with a temperature of 106°, and some lobulated, "rather brawny, enlarged right femoral glands, and definite signs of "pneumonia at the left base behind." He sent the man at once to the Branch Seamen's Hospital in an ambulance. In a register which records sick persons sent from ship to hospital, A. P. was entered as suffering from acute pneumonia.

In the hospital A. P. was placed under the care of Dr. Patrick Manson, the visiting physician; and the Resident Medical Officer, Dr. Rees, attended him throughout his illness.

Dr. Manson was good enough to give me information as to the case; and Dr. Rees, who also kindly assisted me in the matter, has supplied me with hospital notes of A. P.'s case. The latter give the principal facts which came under observation :—

A. P., aged 17, ship's steward, steamship "A." Portuguese native of India. Last voyage from Bombay. Admitted September 29th, 1896. Died 6.30 p.m., October 3rd, 1896. Disease: Bubonic Fever.

September 29th.—Is said to have been ill four days. Company's surgeon says temperature 106° just before admission here. He gave him phenacetin.

---

* I learn that, since my inquiry, the Company has altered its system of dock medical inspection, so that now a detailed return as to each sick person in each vessel is daily made by the surgeon on duty.

No history of any previous illness.

No history of rigor or vomiting.

On admission is extremely ill. Can hardly stand. Is not quite sensible. Lips are dry. Tongue thickly coated with cream-like fur. There is marked injection of conjunctival vessels; alæ nasi work. Respiration 40, shallow. Pulse 136. Temperature 103·8.

Lungs: Both lungs expand well. There is decided hyper-resonance (almost skodaic) in left lung in front. Breathing is harsh in infra-axillary region; a few adventitious sounds heard, crepitant in character. Right apex is suspicious of old phthisis, apparently not active now.

Heart is acting well. Impulse localised and forcible. Right ventricle not dilated. Cardiac dulness is diminished, being in part replaced by the hyper-resonance described above. No murmurs.

Urine: S. G. 1034, high colour. No albumen, no sugar.

Blood: No malarial parasites discovered, but Dr. Manson found some bacilli moving actively amongst red cells, rather slender and long.

Abdomen moves and is flaccid, a little general distention, no fluid, no definite pain, no tenderness. There is a hardish firm mass in right iliac fossa, feeling like and corresponding in position to deep iliac gland. It is a little hot, well circumscribed, with little surrounding induration. No œdema, no spots. There is a similar mass in the position of the right oblique inguinal gland, about 3 inches long and 1 inch wide.

Has a small scabbed score on dorsum of right foot.

There are few small hard glands in either groin. None in axilla or neck.

October 1st.—Has had no sleep. Is quite delirious. Noisy and talking the whole night. Refused all food. Passed urine under him. Brandy has improved character of pulse a little. Tongue more thickly coated. No change in lump in groin. Temperature 103°. Respiration 32.

October 2nd.—Aspect a little improved to-day. Was very drowsy and semiconscious all night, but no true sleep. Is taking food. No sickness. Temperature fell yesterday to 99·6°. Nothing fresh developed in lungs. The mass in femoral region feels more elastic to-day, and there is more surrounding induration and some slight œdema.

Evening.—Is decidedly worse, unconscious, muttering. Tongue dry and sordes on teeth. Pulse 160. Respiration 36. Being fed per rectum.

Many bacilli found in blood to night, straight, slender, and about half a length of red cell, take methyl-blue stain well. Bacilli are found in pairs. Their ends seem a little thickened.

October 3rd.—Has been unconscious all night and occasionally muttering. Much weaker. Mass in thigh is much softer, some redness. Died 6.30 p.m.

In addition to the facts which Dr. Rees has recorded in these notes, I ascertained that, with the exception of the small scabbed sore on the dorsum of the right foot, above referred to, which did not present any sign of inflammation or of suppuration, no local lesion which could be suspected of having caused the enlargement of the glands in the right groin was discovered.* No sign of gonorrhœa or of venereal sore was

* It may be noted that it appears to be common in a case of bubonic plague for the only enlarged glands which are detected on physical examination to be those of the inguinal and femoral chain on one side of the body. Illustrative cases may be found in Dr. Lowson's Report on the Epidemic of Bubonic Plague in Hong Kong in 1894.

apparent, although Dr. Manson and others examined the man carefully in this respect. I learnt also that while in hospital A. P. did not suffer from hæmatemesis, epistaxis, melæna, or other hæmorrhages, his spleen was not felt to be enlarged, and that there was no petechial or other rash upon the skin. The injection of the conjunctivæ referred to in the notes appears to have been particularly noticeable; and those who saw the case in hospital laid stress upon the unusual aspect of the man, which seems to have been comparable to that of a patient severely attacked with a malignant form of an infectious fever.

Post mortem, the enlarged glands of the right groin were cut into. There was serous exudation around these glands, and some turbid fluid, not definitely purulent, within them. Some fluid from the centre of one of the glands was received into sterilized vessels and reserved for bacteriological examination. Tissue of the gland was also taken to be examined microscopically. The fluid specimen had, I learnt, been sent by Dr. Manson to the British Institute of Preventive Medicine. At this Institute the specimen was examined by Dr. Hewlett, who reported to Dr. Manson that "an organism was isolated which agreed in morphology "and in its characters on cultivation and on inoculation with the "descriptions of the bacillus of bubonic plague."

At the request of the Medical Officer, a subculture from this specimen was supplied to the Board by the Institute. Dr. Klein, who, at the Board's instance, made a study of this subculture, reported on November 30th that he found the bacillus to coincide morphologically, culturally, and in respect of its virulence on rodents, with the true plague bacillus.

In view of the clinical and bacteriological evidence it must, I think, be concluded that A. P. died from true bubonic plague.

Another probable Case of Plague on the steamship "A":—On the assumption that I had to do with plague in the case of A. P., it was necessary to inquire whether any other cases of plague or of illness suspicious of plague were to be heard of on the steam-ship "A," or at or near the dock, and, if so, whether such cases could be associated with A. P.'s illness.

First, as regards the steam-ship "A." I examined the log of the whole of the vessel's last voyage from Bombay, and the sick reports for the same voyage. A total of 11 passengers and 16 crew (including only four of the native crew) were entered in the sick reports as having been attended by the ship's surgeon at one or another time during the voyage. Not one of these cases had been fatal, nor did the description given by the surgeon of the illness of any one person give any indication that a case of plague, whether of a severe or of a benign type, had occurred on the voyage.

As to passengers and crew of the vessel after her arrival at the dock, it may, I think, be safely assumed that had any case of plague or illness resembling plague occurred among the passengers after they left the ship for their several destinations, or among officers or other Europeans of the crew, the fact would certainly have been known. No information of the sort was to be heard of. As regards the native crew, record of any ailments among them, which were treated on board when the steamship "A" was in dock, were, for reasons above given, not to be had.

It is customary, however, to transfer to the Branch Seamen's Hospital —to which the Company subscribe largely—any man of a crew who is seriously ill on board any of the Company's vessels in dock. And a

APP. A. No. 12.

On Cases of Illness, suspected to be Bubonic Plague, in the Port of London; by Dr. Buchanan.

book is kept at the dock which records all cases thus transferred to hospital, and also any instance where one of a crew, attacked by fatal illness or accident, has for exceptional reasons not been removed to hospital, but has died on board. From this book I ascertained that on September 27th, a man, P. M., aged 25, had died on board the steam-ship "A," his death being certified as due to acute pneumonia. P. M. was also a "knifeman," or steward's helper, and was also a Portuguee from Goa. None of the Company's ships' surgeons who had seen this man were in England at the time of my inquiry, but I have, through the shipping Company, since received some information as to his illness.

In answer to my inquiries as to the history of the case, and as to possible connexion of the illness with plague, the surgeon who saw this man on September 27 writes: "I saw P. M. alive on one occasion only, " on Sunday, 27th September. His temperature was 105°; he was " cyanosed, with very rapid respirations. The man was quite conscious, " but very exhausted, and evidently dying. On examination of the " chest the physical signs revealed both lungs to be to a large extent " consolidated. The necessary treatment was at once resorted to. About " half an hour later, when I next saw the man, he had just died; death " being preceded, I was told, by somewhat violent struggling.

"Now I believe that this man had got a swelling in one or both " groins, a swelling of considerable size; but, unfortunately, I did not " at the time mark the possible significance of the symptom.

"The only history of the illness which I obtained was to the effect " that the man had been ill four or five days, and had been attended " by one of the surgeons on dock duty. My attention being directed " almost solely to the patient's general condition you will see that my " evidence as to the bubo is not conclusive, but that such a swelling " existed I believe to be the case."

In the above account mention is made of four or five days of illness prior to September 27th. Such illness, however, does not seem to have been severe on these preceding days. It is unlikely that P. M., if severely ill for as much as four or five days, would not have been removed to hospital in accordance with custom. Moreover, another of the Company's ships' surgeons, who saw this man for the first and only time on September 26th, writes that on that date a Portuguese "knifeman," whom he believes to have been P. M., walked to the surgery of the steam-ship "A" complaining only of sore-throat. "His fauces were generally red, " and he had tender but not enlarged submaxillary glands. His tem- " perature was 100°." As his illness appeared slight, the condition of his chest and of his groins did not come under this surgeon's observation. Thus it may, I think, be presumed that P. M. suffered from acute illness only within some 24 hours of his death.

When on board the steam-ship "A," in dock, P. M. may be assumed to have been closely associated with his fellow "knifeman," A. P., in the course of his work. Not only so, but I now learn from inquiries which the Company has been good enough to make for me, that the bunks allotted to these two men were in juxtaposition; both these "knifemen," together with a third reported to have remained well, being quartered in a cabin distinct from that occupied by the other 21 Goanese stewards' helpers on the steasmhip "A."

In view of this history of association of P. M. with A. P., of the circumstance that A. P.'s attack of plague began on the day of P. M.'s sudden and fatal illness, and also because such facts as were to be obtained as to P. M.'s illness show it to have been characterised, in

addition to high fever and signs of pneumonia,* by enlarged glands in the groin, it may be assumed with much probability that P. M. also suffered from bubonic plague.

As to the Means of Infection in these Cases.—Assuming that both these men died from plague, to what source of infection could their attack be referred?

It may be taken that the ordinary period of incubation of plague is between three and five days, while exceptionally it may be more than five days.† The longest period to which I have found reference is nine days (a case cited by Dr. Lowson on p. 7 of his report on the Hong Kong outbreak of 1894).

The steamship "A" arrived at the dock on September 11th. P. M. was severely attacked on the 26th or 27th, while such illness as he had suffered prior to his severe attack seemed to have been of a very few days' duration. A. P. had apparently been first taken ill on September 27th. Thus, even allowing for a possible incubation period of nine days, both these men were to be regarded as having been exposed to their infection after the arrival of the steamship "A" in London.

As regards the relation of the one case with the other, it could readily be understood that P. M. and A. P., when in London, may both have been attacked after coming into relation with some one and the same infected person or infected article, or that P. M., having contracted plague after some exposure to infection, had then transmitted the disease to A. P., with whom he was closely associated. The original source of infection, whether of one or of both men, had still to be inquired into.

Looking first for persons from whom these men might have contracted plague, the question arose whether, when at the dock, any other members of the steamship "A" crew had suffered from illness suspicious of plague—either in its severe or its benign form—antecedently to P. M. and A. P.'s attacks. But although I made careful inquiries on this point I could hear of no such illness. There remained the possibility that A. P. or P. M. had, within the docks, associated with some person or persons not belonging to the steamship "A," who were suffering from plague, or that they had met with sufferers from plague outside the docks altogether.

---

* In connexion with the diagnosis of pneumonia in this case, I may quote from Dr. Lowson's account of the affections of the respiratory system commonly observed in plague at Hong Kong, in 1894:—"Dyspnœa was of an anxious and distressing "character, coming on early in the disease, with rapidity of respiration; the alæ "nasi, however, were soon at work, and the respiration became more rapid "still. The dyspnœa was more of a pneumonic than of an asphyxiative type."

In view of statements that men of native crews on coming to London not unfrequently die suddenly of acute pneumonia, I inquired as to past records of fatal pneumonia occurring at the dock among Goanese employed by the Company. Almost all the "knifemen" or stewards' helpers which this Company employs are, I am told, Portuguese from Goa, and thus the number of these men arriving in London in the course of the year must be considerable. The book to which I have referred recorded, from January 1892 to September 1896, a total of 47 members of crews, either as having been sent to hospital on account of pneumonia or as having died from pneumonia on board. Of these 47 cases 16 had been fatal. But none of the 47 were Goanese, or had Portuguese names, or were returned as stewards helpers.

† An ordinary incubation period of three to five days is given by the Commission of the French Academy of Medicine, which reported on plague in 1844. The same period is given by Hirsch for the "Astrachan" outbreak in 1879, and by other authorities. Lowson gives the period in the Hong Kong outbreak as "generally from three to six days."

At the dock itself I inquired as to suspicious illness or death among crews of other ships, and among the many labourers and other persons employed there. With the exception of the case of a seedie-boy on the steamship "B," M. M., who died in the Branch Seamen's Hospital on September 19th, I learnt of no such antecedent case of suspicious illness or death at the dock. This seedie-boy from the steamship "B" was the fireman referred to by Dr. Collingridge (p. 1). I have given what information I could obtain as to his case in an addendum to this report. Such few clinical facts as were to be had will be seen to be sufficient to warrant a suspicion that M. M. had suffered from plague. But beyond the incomplete clinical evidence obtainable I could obtain no facts which tended to confirm this suspicion Thus no other cases of suspicious illness had occurred in the seedie-boy's quarters on the steamship "B" while this vessel was at the Dock from September 7th to September 25th; and the medical history of passengers and crew during the vessel's voyage from Calcutta to London—she had not called at Bombay — recorded no suspicious illness or death. Similarly, no suspicious illness has been reported to have occurred on the subsequent outward voyage of this same vessel.

The Company's officials kindly got out for me a list of transfers of native crews from one vessel to another at the dock in September. None of the crew of the steamship "B" when in the dock had, I found, been transferrred to another vessel, and there was thus no ground for suspecting the importation to the steamship "A" of any plague-infected person from the steamship "B." And for any close association to take place between a Mohammedan seedie-boy belonging to one vessel and a Portuguese steward's helper belonging to another would, I was informed by the dock superintendent, be a very unusual circumstance.

It could not be determined whether or no either of the men, P. M. or A. P., had gone outside the docks between September 10th and 26th. The dock in question is the easternmost of the London chain of docks, and is thus farther removed than others from inhabited areas. In consequence, I am told, it is usual for native crews not to leave this dock at all. If they do go outside the dock gates, they are believed to restrict their visits to a single road and its neighbourhood. Dr. Sanders, Medical Officer of Health of West Ham, in which borough most of this road and adjacent streets are situate, showed me the return of causes of death in West Ham during each week in August and September. No death which seemed to have a character suspicious of plague was recorded in these returns. Dr. Sanders also at my request instituted inquiries for cases of suspicious illness or death occurring during these months at lodging-houses and other houses in his district known to be frequented by sailors, but without affirmative result.

Further to westward, in the county of London, the matter was brought to the notice of Mr. Shirley Murphy, the county Medical Officer of Health, who instituted extensive inquiries of a similar sort in waterside districts likely to be reached by sailors. Here, again, no cases of suspicious illness or death were heard of.

Dealing, in the next place, with means of exposure to plague infection other than direct association with a previous case of plague, I inquired as to the cargo which the steamship "A" had carried to London from Bombay—the only port visited by this vessel at which plague was known to be prevalent. This cargo had been of miscellaneous composition. But a "knifeman," I was informed, would have nothing whatever to do with the ship's cargo when unloading in dock. And,

App. A. No. 12.

On Cases of Illness, suspected to be Bubonic Plague, in the Port of London; by Dr. Buchanan.

under any circumstances, had some part of the cargo been the source of infection, it was highly improbable that stewards' helpers should alone have been attacked. No live stock had been carried on the voyage. In this connexion I inquired as to death among rats on the steamship "A," but could not learn that any dead rats had been found on the ship when in dock. Moreover the official rat catcher of the Company had made his usual visit to the vessel at the dock, and had caught a number of live rats.

There remained the question whether either of these men had brought with him from Bombay among his personal belongings some article or articles infected with plague. To account for the facts, such hypothetically infected article or articles must have been taken out for the first time when the steamship "A" was in London.

Any member of a native crew can, by the Company's rules, carry personal belongings only in his own chest, kept in the cabin he occupies. At the dock I visited several of the Company's vessels, and in particular the quarters allotted to the Goanese stewards' helpers, and I there examined a number of these chests. I found therein, in the Goanese "knifemen's" quarters, a motley collection of articles of clothing—considerably larger in amount than that carried by native firemen or lascars. Some of these articles had been given away by passengers; other articles, I was told, had been purchased in India before the voyage. Bombay, where the men in question had joined the steamship "A," is, I learnt, the one port where the native crew, being able to associate with their own people, like to be able to spend time and money on shore, and it is there that they obtain or purchase the clothing or other articles which they take on board in their chests.

I was informed that it is unusual for native crew to bring with them cloth garments to take into use when reaching colder climates, as warm outer garments are served out to them by the Company. But undergarments of which I saw a considerable collection in the chests of some of the Goanese "knifemen," are their own. Moreover, the "knifemen's" chests which I saw contained sundry pieces of fancy cloth, coloured handkerchiefs, and similar articles, all obtained in India. Such articles, as well as undergarments, are likely enough to be taken by their owner from their place at the bottom of a chest for the first time when he has arrived in London. Not only would a man who was going outside the docks be likely to look for a coloured handkerchief or other ornamental accessory to his dress, but he would also have occasion to wear such articles within the dock. For it is customary, I was told, at the periodical parades of native crews which are held at the dock for men of these crews to take pains to appear as smart as possible.

Reviewing the facts obtained, it seems that although conclusive evidence is wanting to show that these two men had been attacked with plague in consequence of exposure to some plague-infected article brought with them from Bombay among their personal belongings, and taken from their chests for the first time while the steamship "A" was in dock, yet it must be admitted that such an occurrence was likely, and that infection in this way would be consistent with the various facts of the case which I have set out.

Subsequent History of those associated with P. M. and A. P.

It has already been noted that plague does not appear to have been communicated by these men to any persons in London within the docks. Without the docks, both in West Ham and in the county of London,

the inquiries to which I have already referred did not bring to light any case suspicious of plague.

The steam-ship "A" had sailed on her return journey to Bombay at the time of my visit, part of her native crew having first been transferred to a third vessel, which had also sailed, bound for Calcutta, and part, including the Goanese stewards' helpers, having been retained on board the steam-ship "A." The Company has now forwarded to me the sick reports of passengers and crew on each of these vessels during the months of October and November. No case of illness suspicious of plague is reported from either ship.

Preventive Measures adopted.

Dr. Collingridge had become aware of the suspicions entertained as to the death of A. P. a few days before the date of departure of the steam-ship "A" from the dock on October 10th. By that time part of the native crew had already been transferred to the third vessel referred to, which was to sail on October 9th. Before the departure of each vessel Dr. Collingridge made a thorough examination of the native crew in each case, and took steps to secure fumigation, by means of burning sulphur, of all quarters occupied by them; and the subsequent thorough washing and cleansing of these quarters. Chests belonging to the native crew were left open at the time of fumigation, in order to allow of such disinfection of their contents as was practicable.*

At Dr. Collingridge's suggestion A. P.'s body had been buried in a leaden coffin, with the object of preventing the access of rats or other animals. A. P.'s chest, and all his effects, were burnt at the dock. The suspicious nature of P. M.'s illness not having at that time transpired, similar precautions had not been taken in his case. P. M.'s effects had been, I found, in accordance with custom, sealed in his chest and returned to Bombay.

Close watch for further cases was kept at the dock by the medical advisers of the Company and by Dr. Collingridge, while outside the dock, as has been said, cases in any way suspicious of plague were sought for by the Medical Officer of Health of the county of London, and by Dr. Sanders, of West Ham.

It may be of interest to note that at the time of the occurrence of these cases, Quarantine Regulations were still in force in this country in respect of yellow fever and plague. If these cases of plague originated in the way which I have indicated as affording the most probable explanation of the facts—if, namely, the infecting agent consisted of some plague-infected article purchased in Bombay, kept at the bottom of a sailor's chest until he had occasion to bring it out after his vessel had arrived in dock at London—no system of quarantine, such as these regulations imposed, would have availed to prevent the importation of the disease into the country.

In concluding this report, I take the opportunity of acknowledging the cordial assistance afforded me in the inquiry by the officials of the Company. I am much indebted to the ship surgeon who was detailed

---

* At the time of reporting, I learn that the Company has got out plans, and is commencing the erection at the dock of a shelter for crews that will accommodate a hundred men, and also of a small isolation block and a steam disinfecting apparatus. These commendable arrangements will greatly facilitate future action with regard to cases of infectious disease which occur at the Company's London dock. The Company has also, I understand, ordered disinfecting apparatus for use at certain of its foreign stations.

by the Company to assist me at the dock, and who obtained for me a quantity of useful information. I should also acknowledge my obligation to Dr. Manson and to others who furnished me with the clinical history of the cases.

ADDENDUM.

Note as to the illness of M. M., aged 24, seedie-boy on board the steam-ship "B":—The steam-ship "B," with a crew of 117 hands, passengers, and a general cargo, left Calcutta on August 5th, 1896, and reached London on September 7th. She called at Colombo, Aden, Suez, Marseilles, and Plymouth. Her native crew had been shipped at Bombay on a previous voyage in March. It consisted of 12 Portuguese, 19 lascars, and 40 Africans. The ship's medical reports recorded no cases suspicious of plague at any time during the voyage.

On the visit to the vessel of the Company's surgeon on duty on September 19th, M. M. was found to be seriously ill on board. The dock interpreter ascertained from the man that he had been ill for three or four days previously. Whether or no M. M. had been seen by any ship's surgeon on these antecedent three or four days I was unable to determine.

He was at once sent by the ship's surgeon on duty to the Branch Seamen's Hospital where he was attended by Dr. Rees. He died within a few hours of admission.

The case was nominally put under Mr. Manson's care, but owing to the short time the man lived, Dr. Manson did not see him. Dr. Rees has kindly supplied me with the brief notes which he was able to take in reference to the case.

"M. M., aged 24, coal trimmer, steam-ship 'B.' Native of Bombay. Last voyage from Calcutta. Admitted September 19th, 1896, died same day. Disease: ? Pneumonia.

September 19th.—Patient admitted practically pulseless. Temp.: 98·8. Resp.: 48, pneumonic in type. Alæ nasi are working. Tongue furred and whitish sordes on teeth.

Heart sounds pure, very weak. Lungs: There is some dullness at right base behind. Crepitations are to be heard at either base. Abdomen flaccid; no ascites.

There is a hardish mass to be felt in the right iliac fossa, circumscribed and painful on deep pressure. There is also a tense, dull, non-fluctuating tumour situated in Scarpa's triangle. No impulse. It is a little red, no œdema. Some enlarged inguinal glands in either groin.

There are a few scabbed sores on the right leg. The man is practically dying in a typhoidal condition. Spleen much enlarged. Liver not enlarged. Blood examined, no malarial parasites. Urine drawn off by catheter. Traces of albumen, no blood, no sugar. sp. gr. 1020, acid.

Bowels: Simple enema administered, an ordinary fluid stool resulted.

Patient got very delirious towards the end, and died between four and five hours after admission."

No. 13.

Regulations of 9th November 1896 as to Cholera, Yellow Fever, and Plague: Ports.

App. A. No. 13.

Regulations to Cholera, Yellow Fever and Plague.

To all Port Sanitary Authorities :—
To all other Sanitary Authorities as herein defined ;—
To the Queen's Harbour Masters of Dockyard Ports ;—
To all Officers of Customs ;—
To all Medical Officers of Health of the Sanitary Authorities aforesaid ;—
To all Masters of Ships ;—
To all Pilots ;—
And to all others whom it may concern.

Whereas we, the Local Government Board, are empowered by section 130 of the Public Health Act, 1875, as amended by the Public Health Act, 1896, from time to time to make, alter, and revoke such regulations as to us may seem fit, with a view to the treatment of persons affected with cholera or any other epidemic, endemic, or infectious disease, and preventing the spread of cholera and such other diseases, as well on the seas, rivers, and waters of the United Kingdom, and on the high seas within three miles of the coasts thereof, as on land; and may provide for the enforcement and execution of such regulations;

And whereas by section 1 of the Public Health Act, 1896, it is enacted that regulations of the Local Government Board made in pursuance of section 130 of the Public Health Act, 1875, or in pursuance of that section as extended to London by the Public Health (London) Act, 1891, may provide for such regulations being enforced and executed by the Officers of Customs and the officers and men employed in the coastguard as well as by other authorities and officers, and without prejudice to the generality of the powers conferred by those sections may provide for—

(*a*) the signals to be hoisted by vessels having any case of epidemic, endemic, or infectious disease on board; and
(*b*) the questions to be answered by masters, pilots, and other persons on board any vessel as to cases of such disease on board during the voyage or on the arrival of the vessel; and
(*c*) the detention of vessels and of persons on board vessels; and
(*d*) the duties to be performed in cases of such disease by masters, pilots, and other persons on board vessels: Provided that the regulations shall be subject to the consent—
    (*a*) so far as they apply to the officers of Customs, of the Commissioners of Her Majesty's Customs; and
    (*b*) so far as they apply to officers or men employed in the coastguard, of the Admiralty; and
    (*c*) so far as they apply to signals, of the Board of Trade.

And whereas by certain orders dated respectively the 28th day of August, 1890, and the 6th day of September, 1892, we made regulations with a view to the treatment of persons affected with cholera, and for preventing the spread of the disease, and it is expedient that such orders should be revoked, and that regulations should be made as hereinafter mentioned, to which the Commissioners of Her Majesty's Customs and the Board of Trade have respectively signified their consent so far as such regulations respectively apply to the Officers of Customs and to signals:

App. A. No. 13.

Regulations as to Cholera, Yellow Fever, and Plague.

Now therefore we, the Local Government Board, do hereby revoke the aforesaid orders except in so far as they may apply to any proceedings now pending, and we do by this our order, and in exercise of the powers conferred on us by the Public Health Act, 1875, the Public Health (London) Act, 1891, and the Public Health Act, 1896, and every other power enabling us in that behalf, make the following regulations, and declare that they shall be enforced and executed by the authorities and officers herein-after mentioned :—

Part I.

Art. 1.—In this order—

The term "ship" includes vessel or boat;

The term "Officer of Customs" includes any person acting under the authority of the Commissioners of Her Majesty's Customs;

The term "master," used in relation to a ship, includes the officer, pilot, or other person for the time being in charge or command of the ship;

The term "cholera" includes choleraic diarrhœa;

The term "Sanitary Authority" means every Port Sanitary Authority, and every council of a county borough, and every urban or rural district council whose district includes or abuts on any part of a customs port, which part is not within the jurisdiction of a Port Sanitary Authority;

The term "Local Authority" means any council of a county borough or any urban or rural district council, and in the administrative county of London any Sanitary Authority as defined by the Public Health (London) Act, 1891;

The term "Medical Officer of Health" includes any duly qualified medical practitioner appointed or employed by a Sanitary Authority to act in the execution of this order.

The term "infected" means infected with cholera, yellow fever, or plague: Provided that every ship shall be deemed infected in which there is or has been during the voyage, or during the stay of such ship in the port of departure or in a port in the course of such voyage, any case of cholera, yellow fever, or plague.

Part II.

Art. 2.—(1.) The Officer of Customs who, on the arrival of any ship from foreign, shall visit the ship shall ascertain, so far as possible, whether such ship is infected, and if he have any reason to suspect that the ship is infected or has come from any infected place shall require the master of the ship, or the surgeon, if the ship carries a surgeon, to give (in writing under his hand and in the form hereunto appended or in a form to the like effect) a true answer to the following question :—

Question.—Has any case or suspected case of
Cholera,
Yellow Fever, or
Plague
occurred in the ship , of which you are ,
during the voyage from , or during the stay of the ship in that port or in any other port in the course of the voyage?

Regulations as to Cholera, Yellow Fever, and Plague.

Answer.— cases or suspected cases of occurred on board the during the voyage from [*or* during the stay of the ship in the port of].

or

No case or suspected case of cholera, yellow fever, or plague occurred on board the during the voyage from , or during the stay of the ship in that port or in any other port in the course of the voyage.

Signed

Master [*or* Surgeon] of the .

(2.) The Officer of Customs who, on the arrival of any ship from foreign, shall visit such ship shall, if he find, or have reason to suspect, that the ship is infected, detain such ship, and order the master forthwith to moor or anchor the same in such position as such Officer of Customs shall direct ; and thereupon the master shall forthwith moor or anchor the ship accordingly.

Art. 3.—Whilst such ship shall be so detained, no person (other than an Officer of Customs or a person acting in the execution of this order) shall leave the same.

Art. 4.—The Officer of Customs detaining any ship as aforesaid shall forthwith give notice thereof, and of the cause of such detention, to the Sanitary Authority of the place where such ship is lying.

Art. 5.—Such detention by the Officer of Customs shall cease as soon as the ship shall have been duly visited and examined by the Medical Officer of Health ; or, if the ship shall, upon such examination, be found to be infected, as soon as the same shall be moored or anchored in pursuance of Article 10.

Provided that if the examination be not commenced within twelve hours after the ship shall have been moored or anchored in pursuance of subdivision 2 of Article 2, the ship shall, on the expiration of the said twelve hours, be released from detention.

Part III.

Art. 6.—Every Port Sanitary Authority and every other Sanitary Authority within whose district persons are likely to be landed from ships coming foreign shall, with the approval of the Chief Officer of Customs of the port, fix some place where any ship may be moored or anchored for the purpose of Article 10; and shall make provision for the reception of patients and persons suffering from cholera, yellow fever, and plague, and removed under Articles 13 and 14. The place to be fixed as aforesaid, where any ship may be moored or anchored for the purpose of Article 10, shall be some place within the jurisdiction or district of the Sanitary Authority, unless we otherwise consent; in which case the place so fixed shall, for the purposes of this Order, be deemed to be within such jurisdiction or district.

Provided that, in the case of any dockyard port for which a Queen's Harbour Master has been appointed, the place where any ship shall be moored or anchored for the purpose of Article 10 shall from time to time be fixed by the Port Sanitary Authority with the approval of the Queen's Harbour Master, instead of with that of the chief officer of Customs of the Port.

Provided also, that where, in pursuance of the above-cited order of the twenty-eighth day of August one thousand eight hundred and

ninety, or of any order by the said order revoked, places have been fixed for the mooring or anchoring of ships for the purposes of the regulations by this order revoked, such places shall be deemed to have been so fixed in pursuance of and for the purposes of this order.

Art. 7.—The Sanitary Authority, on notice being given to them by an Officer of Customs, under Article 4, shall forthwith cause the ship in regard to which such notice shall have been given to be visited and examined by their Medical Officer of Health for the purpose of ascertaining whether such ship is infected.

Art. 8.—The Medical Officer of Health, if he have reason to suspect that any ship coming or being within the jurisdiction or district of the Sanitary Authority, whether examined by the Officer of Customs or not, is infected, shall, or, if he have reason to suspect that the ship has come from an infected place, may, visit and examine such ship for the purpose of ascertaining whether such ship is infected; and may make the like visit and examination in the case of any ship coming or being within the jurisdiction of the Sanitary Authority which has come from an infected place. The master of any such ship shall permit the same to be so visited and examined.

The master of any such ship shall also, on being required so to do by the Medical Officer of Health, cause the ship to be brought to, and, if necessary, moored or anchored in some convenient place while the same shall be visited and examined; but due regard shall be had to the safety of the ship and to the convenience of navigation.

Art. 9.—If the Medical Officer of Health, on making such examination as aforesaid (whether under Article 7 or under Article 8), shall be of opinion that the ship is infected, he shall forthwith give a certificate in the following form, or to the like effect, and shall deliver one copy to the master, and retain the other copy or transmit it to the Sanitary Authority. He shall also give to us information as to the arrival of the ship, and such other particulars as we may require.

Certificate.

day of , 189 .

District [*or* Town] Council.
or
Port Sanitary Authority.

I hereby certify that I have examined the ship of , now lying in the port of [*or detained at*], and that I find that such ship is infected with [cholera, *or* yellow fever, *or* plague].

Medical Officer of Health [or medical practitioner appointed or employed by the Sanitary Authority].

Art. 10.—The master of any ship so certified to be infected shall thereupon moor or anchor such ship at the place fixed for that purpose under Article 6, and such ship shall remain there until the requirements of this order have been duly fulfilled.

Art. 11.—No person (other than an officer of Customs or a person acting in the execution of this order) shall leave any such ship until the examination herein-after mentioned shall have been made.

Art. 12.—The Medical Officer of Health shall, as soon as possible after any such ship has been certified to be infected, examine every

Regulations as to Cholera, Yellow Fever, and Plague.

person on board the same, and in the case of any person suffering from cholera, yellow fever, or plague, or from any illness which the Medical Officer suspects may prove to be cholera, yellow fever, or plague, shall certify accordingly.

Art. 13.—Every person certified by the Medical Officer of Health to be suffering from cholera, yellow fever, or plague shall be removed, if his condition admit of it, to some hospital or other suitable place appointed for that purpose by the Sanitary Authority; and no person so removed shall leave such hospital or place until the Medical Officer of Health shall have certified that such person is free from the said disease.

If any person so certified to be suffering from cholera, yellow fever, or plague cannot be removed, the ship shall remain subject, for the purposes of this order, to the control of the Medical Officer of Health; and such person shall not be removed from or leave the ship, except with the consent in writing of the Medical Officer of Health.

Art. 14.—Any person certified by the Medical Officer of Health to be suffering from any illness which such officer suspects may prove to be cholera, yellow fever, or plague, may either be detained on board the ship for any period not exceeding two days, or be taken to some hospital or other suitable place appointed for that purpose by the Sanitary Authority, and detained there for a like period, in order that it may be ascertained whether the illness is, or is not, cholera, yellow fever, or plague.

If any such person, while so detained, shall be certified by the Medical Officer of Health to be suffering from cholera, yellow fever, or plague the provisions of Article 13 shall apply.

Art. 15.—No person on board such a ship as is mentioned in Article 12 who has not been certified as required by that article shall be permitted to land unless he satisfy the Medical Officer as to his name, intended place of destination, and intended address at such place.

Such name, intended place of destination, and address shall forthwith be given by the Medical Officer of Health to the clerk to the Sanitary Authority, and such clerk shall thereupon transmit the same to the Local Authority of the district in which such intended place of destination is situate.

Every such person who, within forty-eight hours after landing, shall arrive at any place of destination or address other than such place or address as aforesaid, shall forthwith upon such arrival notify in writing his place of destination and address to the Medical Officer of Health of the Sanitary Authority, or to the Local Authority, of the district in which such place is situate.

Art. 16.—The Medical Officer of Health shall, in the case of every ship certified to be infected, give directions, and take such steps as may appear to him to be necessary, for preventing the spread of infection, and the master of the said ship shall forthwith carry into execution such directions as shall be so given to him.

Art. 17.—In the event of any death from cholera, yellow fever, or plague taking place on board such ship while detained under Article 10, the master shall, as directed by the Sanitary Authority or the Medical Officer of Health, either cause the dead body to be taken out to sea, and committed to the deep, properly loaded to prevent its rising, or shall deliver it into the charge of the said Authority, who shall thereupon cause the same to be otherwise lawfully and properly disposed of.

App. A. No. 13.

Regulations as to Cholera, Yellow Fever, and Plague.

Art. 18.—The master shall cause the clothing and bedding and other articles of personal use likely to retain infection which have been used by any person who may have suffered from cholera, yellow fever, or plague on board such ship, or who, having left such ship, shall have suffered from cholera, yellow fever, or plague during the stay of such ship in any port, to be disinfected or destroyed; and if the master shall have neglected to do so before the ship arrives in port, he shall forthwith, upon the direction of the Sanitary Authority or the Medical Officer of Health, cause the same to be disinfected or destroyed, as the case may require; and if the said Master neglect to comply with such direction within a reasonable time, the Sanitary Authority shall cause the same to be carried into execution.

Art. 19.—The Master shall cause the ship to be disinfected, and every article therein, other than those last described, which may probably be infected, to be disinfected or destroyed, according to the directions of the Medical Officer of Health.

Art. 20.—Where a ship is not ascertained or certified to be infected, but has passengers on board who are in a filthy or otherwise unwholesome condition, or has come from a place infected with cholera, yellow fever, or plague, the Medical Officer of Health may, if in his opinion it is desirable with a view to checking the introduction or spread of cholera, yellow fever, or plague, give a certificate in duplicate in the following form, or to the like effect, and shall deliver one to the Master and retain the other, or transmit it to the Sanitary Authority:—

Certificate.

day of 189 .

District [*or* Town] Council
or
Port Sanitary Authority.

I hereby certify that I have examined the ship from , now in the port of and that such ship has passengers on board in a filthy or otherwise umwholesome condition [*or* has come from an infected place], and that, in my opinion, it is desirable, with a view to checking the introduction or spread of cholera, yellow fever, or plague, that the persons on board such ship should not be allowed to land unless they satisfy me as to their names, places of destination, and addresses at such places.

Signed .

Medical Officer of Health (or medical practitioner appointed or employed by the Sanitary Authority).

Art. 21.—When such certificate has been given, no person on board the ship shall leave or be allowed to leave the same unless he satisfy the Medical Officer of Health as to his name, intended place of destination, and intended address at such place; and such name, intended place of destination, and address shall forthwith be given by the Medical Officer of Health to the clerk to the Sanitary Authority, and such clerk shall thereupon transmit the same to the Local Authority of the district in which such intended place of destination is situate. Every such person who, within 48 hours after landing, shall arrive at any place of destination or address other than such place or address as aforesaid shall forthwith upon such arrival notify in writing his place of destination and address to the Medical Officer of Health of the Sanitary

Authority or to the Local Authority of the district in which such place is situate.

Art. 22.—If the Medical Officer of Health have reason to believe that any ship coming or being within the jurisdiction of the Sanitary Authority is infected, or has come from an infected place, he may direct all bilge water and water ballast to be pumped out in some suitable place before such ship enters any dock or basin:

Provided that, in every case where there may be reasonable cause to apprehend that the ship may be endangered by the removal of the water ballast, the Medical Officer of Health may cause any tank or other receptacle containing the water ballast to be sealed, and thenceforward, so long as the ship remains within the jurisdiction of the Sanitary Authority, no person shall, without the permission of the Medical Officer of Health, break or remove such seal, or discharge or remove from such tank or receptacle any part of the water ballast.

On the Sanitary Authority providing a proper supply of water for drinking and cooking purposes for persons on board any such ship, the Medical Officer of Health may direct all casks or tanks on board the ship containing water for the use of such persons to be emptied and cleansed, and the master shall cause the said direction to be carried into effect.

Art. 23.—The master of any ship, or any other person, shall answer truly all such questions put to him by, and give all such information to, any Officer of Customs or Medical Officer of Health as may be necessary for any purpose of this order; and no person who is required in pursuance of this order to give to the Medical Officer of Health or to notify to any Local Authority the name and intended place of destination and address of such person shall knowingly give or notify a false or fictitious name, place of destination or address, or refuse to give or notify as aforesaid the true name, intended place of destination, and address of such person.

Art. 24.—The Sanitary Authority may appoint one or more legally qualified medical practitioners to act in the execution of this order, either in place of or as an assistant or assistants to the Medical Officer of Health, and may pay such practitioner or practitioners reasonable remuneration for his or their services.

Part IV.

Art. 25.—The master of every ship infected with cholera, yellow fever, or plague shall, within three miles of the coast of any part of England or Wales, cause to be hoisted at the masthead, or where best seen, a large flag of yellow and black, borne quarterly, and shall keep the same displayed during the whole of the time between sunrise and sunset, and no person (other than an Officer of Customs or a person acting in the execution of this Order) shall leave such ship until after such visit of the Officer of Customs as mentioned in Article 2, or until after the visit of the Medical Officer of Health in pursuance of Article 8.

Part V.

Art. 26.—Nothing in this order shall render liable to detention, disinfection, or destruction any article forming part of any mail (other than a parcel mail), conveyed under the authority of the Postmaster-General, or of the postal administration of any foreign Government, or

shall prejudicially affect the delivery in due course of any such mail (other than a parcel mail) to the post office in accordance with the provisions of the Post Office Acts.

Given under the Seal of Office of the Local Government Board, this ninth day of November, in the year One thousand eight hundred and ninety-six.

(L.S.) HENRY CHAPLIN,
President.

HUGH OWEN,
Secretary.

NOTICE.—The Public Health Act, 1896, provides by sub-section (3) of section 1 that if any person wilfully neglects or refuses to obey or carry out, or obstructs the execution of, any regulation made under section one hundred and thirty of the Public Health Act, 1875, or in pursuance of that section as extended to London by the Public Health (London) Act, 1891, and as amended by the Public Health Act, 1896, he shall be liable to a penalty not exceeding one hundred pounds, and in the case of a continuing offence to a further penalty not exceeding fifty pounds for every day during which the offence continues.

No. 14.

Rescinding Order as to Bedding and Clothing from certain Countries.

Cholera Regulations.—Bedding and Clothing from France, from certain Ports on the Baltic and on the North Sea, and from Ports on the Black Sea and Sea of Azov, and other Ports of Turkey in Asia: Rescinding Order of 21st December 1896.

To all Port Sanitary Authorities;—
To all Urban and Rural District Councils;—
To all Medical Officers of Health of the District Councils aforesaid;—
To all Officers of Customs;—
To all Masters of Ships;—
And to all others whom it may concern.

Whereas by an order dated the 5th day of August 1893 we, the Local Government Board, directed that from and after the 9th day of August 1893, and until we should by order otherwise direct, no dirty bedding or disused or filthy clothing, whether belonging to emigrants or otherwise, from France or from any foreign port in Europe north of Dunkirk other than ports of Sweden, Norway, and Denmark, or from any port on the Black Sea or Sea of Azov, whether in Russia, Roumania, Bulgaria, or Turkey, or from any other port of Turkey in Asia, should be delivered overside, except for the purpose of disinfection or destruction, nor landed in any port or place in England or Wales, except for the purpose of disinfection or destruction, and by the said order we made certain provisions with regard to such disinfection or destruction and other matters;

And whereas for the purpose of removing doubts as to the interpretation of certain terms used in the said order, we issued a further order, dated the 13th day of September 1893;

And whereas it is expedient that the above-cited orders should be rescinded;

Now therefore, in pursuance of the powers given to us by the statutes in that behalf, we hereby rescind the said order dated the fifth day of August one thousand eight hundred and ninety-three, except in so far as it revokes certain regulations previously made by us, and the said order dated the thirteenth day of September one thousand eight hundred and ninety-three.

Given under the seal of office of the Local Government Board, this twenty-first day of December, in the year one thousand eight hundred and ninety-six.

(L.S.) Henry Chaplin,
President.

S. B. Provis,
Assistant Secretary.

APP. A. No. 15.

School Restrictions in relation to Prevention of Infectious Disease.

No. 15.

MEMORANDUM, prepared in the MEDICAL DEPARTMENT, on the CIRCUMSTANCES under which the CLOSING of PUBLIC ELEMENTARY SCHOOLS or the EXCLUSION therefrom of particular CHILDREN may be required in order to prevent the SPREAD of DISEASE.

Objects of memorandum.

1. It is attempted in these notes to bring together the information in the possession of the Local Government Board, derived from the reports of the Board's own Medical Inspectors and of local Medical Officers of Health, respecting school-closure and exclusion from school as precautions against infection, with a view to indicate the best means of preventing the spread of disease by school children among their fellows, while avoiding any unnecessary interruption of the work of education.

Regulations of Education Department.

2. In the Code of Regulations approved by the Lords of the Committee of Council on Education, the following Article (Art. 88) prescribes, as one of the general conditions required to be fulfilled by a Public Elementary School in order to obtain an annual Parliamentary grant, that—

"The managers must at once comply with any notice of the sanitary authority of the district in which the school is situated, or any two members thereof, acting on the advice of the Medical Officer of Health, requiring them for a specified time, with a view to preventing the spread of disease, or any danger to health likely to arise from the condition of the school, either to close the school, or to exclude any scholars from attendance, but after complying they may appeal to the Department if they consider the notice to be unreasonable."

Article 83 (a) prescribes that "if a school has been closed during " the year under medical authority, or for any unavoidable cause, a " corresponding reduction is made from the number of meetings" (400 a year) required.

Article 101* provides that where the Education Department "are " satisfied that by reason of a notice of the Sanitary Authority under " Art. 88, or any provision of an Act of Parliament, requiring the " exclusion of certain children, or by reason of the exclusion under " medical advice of children from infected houses, the average " attendance has been seriously diminished, and that consequently " a loss of annual grant would, but for this Article, be incurred, the " Department have power to make a special grant not exceeding " the amount of such loss in addition to the ordinary grant."

Diseases principally requiring action.

3. The diseases for the prevention of which school closure, or the exclusion of particular children, will be required are principally those which spread by infection directly from person to person, such as diphtheria, scarlet fever, measles, whooping-cough, epidemic influenza, small-pox, and rötheln. More rarely, the same questions arise in connexion with enteric fever and diarrhœal diseases, which spread not so much by direct infection from person to person as indirectly through the agency of local conditions, such as infected school privies.

4. It will be seen that Article 88, quoted above, confers upon sanitary authorities an alternative power with respect to public elementary schools.

(A.) To cause particular scholars to be for a specified time excluded from attendance, or

(B.) To require the school to be closed for a specified time.

Exclusion of scholars:

5.—*A. First, as to exclusion from school of particular scholars.*—Here it will be convenient to consider the circumstances under which

the requirements of the public health will be satisfied by the less severe measure of the exclusion from school of particular children.

School Restrictions in relation to Prevention of Infectious Disease.

(*a.*) It may be laid down as a universal principle that all children suffering from any dangerous infectious disorder (*i.e.*, of a nature dangerous to some of the persons attacked by it, however mild in other cases) should be excluded from school until there is reason to believe that they have ceased to be in an infectious condition (*see* section 126 of the Public Health Act, 1875).

from infected houses,

(*b.*) Furthermore, as it is rarely possible to provide effectual separation of the sick from the healthy within the homes of children of the class attending public elementary schools, it must commonly be necessary that all children of an infected household should be excluded from school; first, because otherwise such children might attend school while suffering from the disease in a latent form, or at an unrecognised stage, and, secondly, because it is known that infection may attach itself to, and be conveyed by, the clothes of a person living in an infected atmosphere, even though the person himself remain unaffected. The same considerations will sometimes make it desirable to prohibit the attendance at school of all children from a particular street or hamlet.

from particular localities.

In the case of infectious diseases involving little or no danger to life, such as mumps or skin diseases, school interests may be more particularly considered. In such case, however, it will usually be well for the Medical Officer of Health to advise the managers to prohibit the attendance of every child while in an infectious state.

Closing of schools:

6.—*B. Secondly, as to the closing of schools.*—This, by more seriously interfering with the educational work of a district, is a much more grave step for a sanitary authority to take than to direct the exclusion of particular scholars. It is a measure that seldom ought to be enforced, except under circumstances involving imminent risk of an epidemic, nor even then as a matter of routine nor unless there be a clear prospect of preventing the propagation of disease, such as could not be looked for from less comprehensive action.

when to be required.

The mere fact that in an epidemic many of the sufferers are school children does not necessarily show that the disease was caught at school; but the school may with probability be regarded as spreading infection if in a large majority of households attacked the first case be a child attending school; and with still greater probability if a number of children living at a distance from one another, and with no circumstances in common, except that they attend the same school, should be simultaneously attacked, and if it can be ascertained that a child or teacher in an infectious state has actually been attending the school.

Duty of Medical Officer of Health when infectious disease occurs.

7. By Article 18 (6) of the Board's Order of 23rd March, 1891, the Medical Officer of Health on the occasion of an outbreak of dangerous infectious disease is to advise the persons competent to act as to the measures to be taken to prevent the extension of the disease. If, therefore, he finds that the children of infected households are attending school, he should send notice of the fact to the schoolmaster, and give such advice as appears to him to be necessary with regard to the exclusion of the children from school, and as to the time for which such exclusion should continue.

Where the number of children to be excluded is small, and the schoolmaster acts on the advice of the Medical Officer of Health, it may not be necessary to take formal action under Article 88 of the Code;

App. A. No. 15.

School Restrictions in relation to Prevention of Infectious Disease.

but where the number of children whom it is desirable to exclude from school is such as is likely seriously to diminish the average attendance, or where the advice of the Medical Officer of Health is not followed, and there is danger of the disease spreading by means of the school, notice for the exclusion of the children in question should be made in accordance with the requirements of Article 88.

Aid which schoolmasters and others can give.

The attention of school attendance officers and of schoolmasters should also be drawn to the following considerations. Frequently they themselves will obtain the earliest information of the occurrence of infectious disease among scholars, and it is most desirable that such officer or master should without delay communicate the facts to the Medical Officer of Health. Absence of any child from school on the plea that it is suffering under one of the before-mentioned diseases, and absence of several children of one family from school at the same time, no matter what name be given to the complaint that keeps them at home, should be reported to the health officer. In practice it has been found that this notification of absentees has materially aided the local health officer in taking measures for the suppression of infectious disease, to the advantage alike of the district and of the school. Furthermore, schoolmasters may properly be asked to take note, especially when an epidemic threatens or is present, of symptoms occurring in any of their scholars that may indicate the commencement of disease, febrile in nature. Besides heat of skin, such symptoms are shivering, headache, and languor, especially if commencing suddenly, vomiting, rashes on the skin, and sore throat. When scarlet fever or diphtheria is about, every trace of sore throat should be looked upon as suspicious. In any case where such symptoms are observed, the safest course will be to exclude the child from school until assurance can be had that it may attend school without harm to itself or danger to other scholars.

Exclusion of particular scholars; duration of.

8. As regards duration of exclusion from school of particular children, the time to be specified will vary in different diseases and different cases, and in this matter the sanitary authority will doubtless be guided by the advice of their Medical Officer of Health.

Considerations which should determine period.

Medical officers of health, having to specify a time during which any scholars are to be excluded from attendance at any school, should have regard as far as practicable to the circumstances of the particular scholars suffering from infectious disease or living in infected households. Not only the nature of the infection and the length of illness, but the environments of the individual as affecting the retention of infection will deserve consideration. The period of exclusion, for example, will need to be different according to the conditions of a patients' lodgment, according to the sufficiency of the separation that can be effected between a patient and excluded scholars, and according to the opportunities of effectual disinfection that can be afforded to the household. Thus a hard and fast rule, such as has been laid down in some districts where scarlatina has been present, that no child shall go to school from an infected house for three months after the disease has begun in that house, is not to be commended. It is indeed possible that under the circumstances of a particular household, a child convalescent from scarlatina or living in the same house with convalescents should not in the interests of other children be permitted to return to school until after so long a period as this; but the same ought not to be assumed of all households in the district that may be invaded by

scarlatina. The better plan would be for the sanitary authority to secure, during a shorter period, the exclusion of individual sick persons and their housemates from school; and when that period is about to expire to cause fresh inquiry to be made as to the expediency of further exclusion, and, if found requisite in particular cases, to cause fresh notice to be given to the school managers.

School Restrictions in relation to Prevention of Infectious Disease.

Period of exclusion may be prolonged by new notice.

9. In deciding whether an outbreak of infectious disease among children of school age may be best combated by closing the school, or whether it will suffice to exclude the children of infected households, the two most important points to be considered are:—

Whether exclusion or school closure to be preferred.

(*a.*) The completeness and promptness of the information received by the officers of the sanitary authority respecting the occurrence of infectious cases.

(*b.*) The opportunities which exist for intercourse between the children of different households elsewhere than at school.

10. (*a.*) The more prompt and full the knowledge of cases of infectious disease that the sanitary authority are able to obtain, the better will be the prospect of checking such disease by keeping away from school the children of infected households, and the less will be the necessity for closing schools.* If the cases be few in number, and their origin known, the exclusion from school of the children of infected households will probably suffice, but this measure will fail where there are many undiscovered or unrecognised cases, or where the known centres of infection are very numerous.

When exclusion system to be preferred.

Commonly, the failure of carefully considered measures of exclusion to stay the spread of an epidemic which shows a special incidence upon school children, may be regarded as pointing to the continued attendance at school of children with the prevalent disease in a mild or unrecognised form, and a strong case will appear for the closing of schools.

When total closure of school preferable.

If by reason of the absence or exclusion of a large number of children, the attendance at a school be greatly reduced, it may be found better to close it altogether. This is especially apt to occur in the case of epidemics of measles, a disease which is very infectious in the early stages, before the characteristic rash has appeared, and while the symptoms resemble those of a common cold.

11. (*b.*) The second material consideration, in deciding as to the desirability of closing schools during the prevalence of infectious disease, is the amount of opportunity for intercommunication between the members of different households elsewhere than at school. In sparsely populated rural districts, where the children of different households, or of separate hamlets, rarely meet except at, or on their way to, the village school, the closing of the school is likely to be effectual in checking the spread of disease. It is less likely to be useful in a town or compact village (particularly where houses are sub-let and yards are in common), where the children of different households when not at school, spend their time in playing together, and often run in and out of each other's houses. But it must be remembered that children when at play out of doors are brought into much less close association with each other than when in school.

Closure of schools:—

in rural districts,

in populous localities,

In rural districts, where epidemic diseases are less frequently prevalent, school closing may be required as an exceptional measure to meet an exceptional state of things. As regards more populous places,

* Information obtainable under the Infectious Disease (Notification) Act, 1889, will be especially useful in this direction.

App. A. No. 15.

School Restrictions in relation to Prevention of Infectious disease.

it must not be forgotten that if schools were to be closed whenever an infectious disease was prevalent, there are many places where schools would hardly ever be open.

for purposes of Disinfection, &c.,

It will sometimes be necessary to close a school for a day or two to allow of the rectification of sanitary defects of a nature to extend disease, or in order that the school may be disinfected or purified. It has happened that infectious sickness in the master's family has forbidden the attendance of scholars. These more temporary and occasional closures of schools are contemplated in the Education Code, and are to be regarded as having a real importance of their own.

where many schools exist.

12. In places where there are several public elementary schools, if an outbreak of infectious disease be confined to the scholars of one particular school, it may be sufficient to close that school only. But where different schools have all appeared to aid in the spread of disease (though perhaps to an unequal extent) the sanitary authority may consider it advisable that all should be closed lest children in an infectious state who previously attended the schools that are closed, should be sent to others that might remain open.

Sunday and private schools.

It must be remembered that sanitary authorities have no power in respect of Sunday Schools, or other private schools: except in so far as these may contravene section 91 (5), section 126, or other provision of the Public Health Act, 1875; but it will often be expedient to invite the co-operation of managers of such schools in efforts for securing the public health. Experience shows that they are usually ready to defer to the representations of the authority responsible for the public health of the district.

Duty of Medical Officer of Health as to reporting.

Grounds for action to be stated.

13. Reports to sanitary authorities, advising the closure of a school or schools in any district, are to be treated as "special" reports within the meaning of the General Order of the Local Government Board of March 23rd, 1891, and copies of them are required by Art. 18 (15) and (16) of that Order to be sent to the Board, and to the County Council. These reports should state the grounds upon which the Medical Officer of Health advocates the closure of the school or schools in preference to the exclusion of particular scholars.

Notices requiring closure of schools.

14. All notices of the sanitary authority for the closing of Public Elementary Schools should be addressed in writing to the Managers, and should state the grounds on which the closing is deemed necessary.

All such notices shall specify a definite time during which the school is to remain closed; this should be as short a period as can be regarded as sufficing on sanitary grounds, since a second notice may be given before the expiration of the first, if it should be found necessary to postpone the re-opening of a school. The Managers of schools, after complying with the requirements of the sanitary authority, have the right of appeal to the Education Department, if they consider any notice to be unreasonable.

July 1897. RICHD. THORNE THORNE.

Nos. 16 and 16 (a).

App. A. No. 16.

Compilation of Returns of Notified Infectious Diseases and registered Deaths therefrom.

Compilation of Returns of Notified Cases of certain Infectious Diseases, and Registered Deaths therefrom.

1896.

It should be noted, with reference to these returns, that some of the districts to which they apply administer compulsory notification under local Acts; and that not only are some of the diseases named in the Infectious Disease (Notification) Act of 1889 not notifiable under some of the local Acts, but that under certain of these Acts no payment is made for the notification of multiple attacks of the same disease occurring in the same house within a specified date of the first attack notified.

The Urban Districts finding place in these returns in which compulsory notification has been adopted under local Acts are—

Accrington.
Ashton-under-Lyne.
Birkenhead.
Blackburn.
Bolton.
Burnley.
Bury.
Croydon.
Darwen.
Derby.
Halifax.
Hartlepool.
Huddersfield.
Leicester.
Manchester.
Newcastle-on-Tyne.
Norwich.
Nottingham.
Oldham.
Preston.
Reading.
Rotherham.
Stockton-on-Tees.
Sunderland.
Swansea.
Wakefield.
Warrington.
West Ham.
Wigan.
Willesden.
York.

APP. A. No. 16.

Compilation of Returns of Notified Infectious Diseases, and registered Deaths therefrom.

No. 16.

TABLE showing Quarter by Quarter, during the Year 1896, for each of REGISTERED DEATHS from the under-mentioned DISEASES, together SANITARY DISTRICTS in question.

[The Cases are a Summary of the Weekly Returns of Notifiable Diseases received Quarterly Returns of

In Registration Divisions.	Urban Sanitary Districts.	Population (1891).	SMALL-POX.									
			1st Quarter.		2nd Quarter.		3rd Quarter.		4th Quarter.		Total for 1896.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
I.	London (*Administrative Co.*)	4,232,118	94	5	77	3	51	1	5	—	227	9
II. South-Eastern.	Croydon	102,695	1	—	—	—	—	—	—	—	1	—
	Dover	33,300	—	—	—	—	—	—	—	—	—	—
	Eastbourne	34,969	—	—	—	—	—	—	—	—	—	—
	Bournemouth	37,781	—	—	1	—	—	—	—	—	1	—
	Southampton	65,325	4	—	5	1	—	—	—	—	9	1
	Reading	60,054	1	—	10	—	—	—	—	—	11	—
III. South Midland.	Willesden	61,265	2	—	—	—	—	—	—	—	2	—
	Hornsey	44,205	6	—	1	—	1	—	—	—	8	—
	Tottenham	71,343	—	—	—	—	—	—	—	—	—	—
	Oxford	45,742	23	—	1	—	—	—	—	—	24	—
	Northampton	61,012	—	—	—	—	—	—	—	—	—	—
	Cambridge	36,983	1	—	—	—	—	—	—	—	1	—
IV. Eastern.	Leyton	63,056	—	—	—	—	—	—	—	—	—	—
	Walthamstow	46,346	—	—	—	—	—	—	—	—	—	—
	West Ham	204,903	44	3	15	1	—	—	—	—	59	4
	Colchester	34,559	—	—	—	—	—	—	—	—	—	—
	Norwich	100,970	—	—	—	—	—	—	—	—	—	—
V. South-Western.	Exeter	37,404	3	1	27	1	—	—	—	—	30	2
	Plymouth	84,248	—	—	—	—	—	—	—	—	—	—
	Devonport	54,803	—	—	2	—	—	—	—	—	2	—
	Bath	51,844	—	—	—	—	—	—	—	—	—	—
VI. West Midland.	Bristol	221,578	22	1	20	4	—	—	—	—	42	5
	St. George	36,718	1	—	1	—	—	—	—	—	2	—
	Gloucester	39,444	709	144	1,266	277	23	6	—	—	1,998	427
	Burton-on-Trent	46,047	5	—	—	—	—	—	—	—	5	—
	Wolverhampton	82,662	2	—	1	—	—	—	—	—	3	—
	Walsall	71,789	—	—	—	—	—	—	1	—	1	—
	West Bromwich	59,474	—	—	—	—	—	—	—	—	—	—
	Worcester	42,908	1	—	3	—	—	—	—	—	4	—
	Smethwick	36,170	—	—	5	—	—	—	—	—	5	—
	Birmingham	478,113	2	—	12	—	2	—	1	—	17	—
	Aston Manor	68,639	—	—	—	3	—	1	—	—	—	4
	Coventry	52,724	—	—	—	—	3	—	—	—	3	—
VII. North Midland.	Leicester	174,624	—	—	—	—	—	—	—	—	—	—
	Grimsby	51,934	—	—	—	—	—	—	—	—	—	—
	Nottingham	213,877	—	—	—	—	—	—	—	—	—	—
	Derby	94,146	—	—	2	—	2	—	—	—	4	—

No. 16.

Compilation of Returns of Notified Infectious Diseases, and registered Deaths therefrom.

81 Urban Sanitary Districts, the Number of Notified Cases and of
with an Annual Summary of these data for each of the Urban
by the Board from Medical Officers of Health. The Deaths are extracted from the
the Registrar-General.]

In Registration Divisions.	Urban Sanitary Districts.	Population (1891).	Small-Pox—*continued.* 1st Quarter. Cases.	1st Quarter. Deaths.	2nd Quarter. Cases.	2nd Quarter. Deaths.	3rd Quarter. Cases.	3rd Quarter. Deaths.	4th Quarter. Cases.	4th Quarter. Deaths.	Total for 1896. Cases.	Total for 1896. Deaths.
VIII. North-Western.	Stockport - -	70,263	—	—	1	—	—	—	—	—	1	—
	Macclesfield - -	36,000	—	—	—	—	—	—	—	—	—	—
	Birkenhead - -	99,857	—	—	—	—	—	—	—	—	—	—
	Liverpool -	629,443	—	—	—	—	2	—	6	—	8	—
	St. Helens (Lancs.) -	71,288	—	—	—	—	—	—	—	—	—	—
	Southport - -	41,406	—	—	—	—	—	—	—	—	—	—
	Wigan - - -	55,013	32	3	3	—	—	—	—	—	35	3
	Warrington - -	52,743	—	—	—	—	1	—	—	—	1	—
	Bolton - - -	115,002	—	—	1	—	—	—	—	—	1	—
	Bury (Lancs.) - -	57,212	—	—	—	—	—	—	1	—	1	—
	Salford - - -	198,139	5	—	—	—	—	—	—	—	5	—
	Manchester - -	505,368	—	—	1	—	—	—	—	—	1	—
	Ashton-under-Lyne -	40,463	—	—	—	—	—	—	—	—	—	—
	Oldham - - -	131,463	21	—	5	—	—	—	1	—	27	—
	Accrington - -	38,603	—	—	—	—	—	—	—	—	—	—
	Burnley - - -	87,016	—	—	1	—	—	—	—	—	1	—
	Blackburn - -	120,064	—	—	—	—	—	—	—	—	—	—
	Darwen - - -	34,192	—	—	—	—	—	—	—	—	—	—
	Preston - - -	107,573	—	—	—	—	—	—	—	—	—	—
	Barrow-in-Furness -	51,712	—	—	—	—	—	—	—	—	—	—
IX. Yorkshire.	Huddersfield - -	95,420	1	—	—	—	—	—	—	—	1	—
	Halifax - - -	89,832	—	—	—	—	—	—	—	—	—	—
	Bradford - -	216,361	1	1	—	—	—	—	—	—	1	1
	Leeds - - -	367,505	—	—	2	1	—	—	—	—	2	1
	Wakefield - - -	33,146	—	—	—	—	—	—	—	—	—	—
	Barnsley - -	35,427	—	—	1	—	—	—	—	—	1	—
	Sheffield - -	324,243	—	—	—	—	—	—	—	—	—	—
	Rotherham - -	42,061	2	—	—	—	—	—	2	—	4	—
	York - - -	67,004	—	—	—	—	—	—	—	—	—	—
	Hull - - -	200,044	2	—	6	—	—	—	2	—	10	—
	Middlesbrough - -	75,532	—	—	—	—	—	—	—	—	—	—
X. Northern.	Darlington - -	38,060	—	—	—	—	—	—	—	—	—	—
	Stockton-on-Tees -	49,705	—	—	—	—	—	—	—	—	—	—
	West Hartlepool -	42,710	—	—	2	—	—	—	—	—	2	—
	Sunderland - -	131,015	—	—	1	—	—	—	—	—	1	—
	South Shields - -	78,391	15	—	—	—	—	—	1	—	16	—
	Newcastle-on-Tyne -	186,300	—	—	—	—	—	—	—	—	—	—
	Tynemouth - -	46,588	1	—	2	—	2	—	1	—	6	—
	Carlisle - - -	39,176	—	—	—	—	1	—	—	—	1	—
XI. Welsh.	Newport (Mon.) -	54,707	12	3	—	—	—	—	—	—	12	3
	Cardiff - - -	128,915	33	2	9	1	—	—	1	—	43	3
	Merthyr Tydfil - -	58,080	11	1	—	—	—	—	—	—	11	1
	Swansea - -	90,349	34	2	28	—	—	—	—	—	62	2
	Totals, 81 Districts -	12,369,163	1,091	166	1,512	292	88	8	22	—	2,713	466

App. A. No. 16.

Compilation of Returns of Notified Infectious Diseases, and registered Deaths therefrom.

In Registration Divisions.	Urban Sanitary Districts.	Population (1891).	Scarlet Fever.									
			1st Quarter.		2nd Quarter.		3rd Quarter.		4th Quarter.		Total for 1896.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
I.	London - - (*Admin. Co.*)	4,232,118	4,778	264	4,889	197	8,162	218	7,847	263	25,676	942
II. South-Eastern.	Croydon -	102,695	63	—	58	1	73	1	98	3	292	5
	Dover - -	33,300	17	1	12	—	5	—	9	—	43	1
	Eastbourne -	34,969	28	—	13	—	13	—	20	1	74	1
	Bournemouth -	37,781	13	—	5	—	17	—	54	1	89	1
	Southampton -	65,325	142	3	179	4	275	2	314	16	910	25
	Reading -	60,054	62	4	29	1	22	—	22	—	135	5
III. South Midland.	Willesden -	61,265	116	6	72	3	122	1	171	6	481	16
	Hornsey -	44,205	37	—	136	3	209	4	152	2	534	9
	Tottenham -	71,343	104	4	123	2	213	2	272	8	712	16
	Oxford - -	45,742	65	1	14	1	17	—	25	—	121	2
	Northampton -	61,012	64	1	38	2	140	4	142	3	384	10
	Cambridge -	36,983	15	1	28	1	21	1	24	2	88	5
IV. Eastern.	Leyton - -	63,056	135	2	116	2	139	2	181	—	571	6
	Walthamstow -	46,346	51	1	58	—	90	2	113	3	312	6
	West Ham -	204,903	466	13	360	9	447	18	356	15	1,629	55
	Colchester -	34,559	37	1	33	—	25	—	45	1	140	2
	Norwich -	100,970	43	1	31	1	108	—	239	2	421	4
V. South-Western.	Exeter - -	37,404	25	—	17	—	12	—	9	—	63	—
	Plymouth -	84,248	25	—	32	2	31	—	30	1	118	3
	Devonport -	54,803	6	—	10	1	13	1	20	—	49	2
	Bath - -	51,844	16	—	16	1	14	1	96	6	142	8
VI. West Midland.	Bristol - -	221,578	368	19	346	18	298	12	358	10	1,370	59
	St. George -	36,718	95	4	58	—	37	1	16	—	206	5
	Gloucester -	39,444	7	—	17	—	21	1	30	1	75	2
	Burton-on-Trent	46,047	87	2	40	3	53	1	99	11	279	17
	Wolverhampton	82,662	72	6	64	1	100	7	145	7	381	21
	Walsall - -	71,789	34	—	61	5	179	4	245	12	519	21
	West Bromwich	59,474	121	17	65	5	66	3	71	6	323	31
	Worcester -	42,908	31	—	23	—	92	2	149	2	295	4
	Smethwick -	36,170	41	—	60	2	94	4	75	—	270	6
	Birmingham -	478,113	815	36	759	46	926	24	902	42	3,402	148
	Aston Manor -	68,639	124	5	144	2	153	1	192	6	613	14
	Coventry -	52,724	46	1	45	2	133	2	93	5	317	10
VII. North Midland.	Leicester -	174,624	191	3	288	7	670	16	953	24	2,102	50
	Grimsby - -	51,934	86	3	32	2	14	1	13	1	145	7
	Nottingham -	213,877	248	7	168	9	151	7	159	3	726	26
	Derby - -	94,146	104	2	125	4	94	1	110	4	433	11

App. A. No. 16.

Compilation of Returns of Notified Infectious Diseases, and registered Deaths therefrom.

In Registration Divisions.	Urban Sanitary Districts.	Population (1891).	Scarlet Fever—*continued.* 1st Quarter. Cases.	1st Quarter. Deaths.	2nd Quarter. Cases.	2nd Quarter. Deaths.	3rd Quarter. Cases.	3rd Quarter. Deaths.	4th Quarter. Cases.	4th Quarter. Deaths.	Total for 1896. Cases.	Total for 1896. Deaths.
VIII. North-Western.	Stockport - -	70,263	50	3	85	7	127	8	104	2	366	20
	Macclesfield -	36,009	5	—	6	1	10	1	7	—	28	2
	Birkenhead -	99,857	51	2	82	1	108	6	362	23	603	32
	Liverpool - -	629,443	708	38	593	31	946	54	1,378	104	3,625	227
	St. Helens (Lancs.)	71,288	124	7	208	10	308	14	673	30	1,313	61
	Southport - -	41,406	58	2	35	3	199	7	187	6	479	18
	Wigan - -	55,013	33	3	57	1	33	2	32	1	155	7
	Warrington -	52,743	38	1	20	3	18	1	36	4	112	9
	Bolton - -	115,002	249	11	233	17	180	7	125	5	787	40
	Bury (Lancs.) -	57,212	59	4	96	2	97	6	117	4	369	16
	Salford - -	198,139	262	20	387	31	541	30	375	23	1,565	104
	Manchester -	505,368	628	53	580	53	695	50	515	41	2,418	197
	Ashton-under-Lyne	40,463	70	7	45	6	71	3	89	4	275	20
	Oldham - -	131,463	142	10	156	11	285	22	205	13	788	56
	Accrington - -	38,603	39	1	31	1	35	1	77	5	182	8
	Burnley - -	87,016	32	2	25	1	32	1	18	—	107	4
	Blackburn - -	120,064	43	3	53	1	81	2	108	3	285	9
	Darwen - -	34,192	10	—	18	—	90	2	26	3	144	5
	Preston - -	107,573	22	—	18	—	24	1	44	2	108	3
	Barrow-in-Furness	51,712	35	—	20	—	16	2	57	2	128	4
IX. Yorkshire.	Huddersfield -	95,420	94	7	123	7	115	3	124	2	456	19
	Halifax - -	89,832	5	—	14	—	7	—	18	—	44	—
	Bradford - -	216,361	87	5	87	2	138	11	82	6	394	24
	Leeds - -	367,505	167	11	139	7	350	20	557	33	1,213	71
	Wakefield - -	33,146	61	5	48	4	35	4	33	2	177	15
	Barnsley - -	35,427	59	5	63	8	104	4	101	6	327	23
	Sheffield - -	324,243	374	25	485	15	503	30	677	32	2,039	102
	Rotherham -	42,061	73	3	52	—	67	1	61	1	253	5
	York - -	67,004	38	2	67	—	52	2	34	1	191	5
	Hull - - -	200,044	497	13	362	16	183	3	425	25	1,467	57
	Middlesbrough -	75,532	808	9	316	8	175	5	115	6	1,414	28
X. Northern.	Darlington - -	38,060	90	4	90	6	54	2	41	3	275	15
	Stockton-on-Tees -	49,705	152	4	90	1	38	4	26	—	306	9
	West Hartlepool -	42,710	58	2	36	3	60	4	67	7	221	16
	Sunderland -	131,015	140	8	122	6	138	6	208	7	608	27
	South Shields -	78,391	84	3	96	4	127	4	191	4	498	15
	Newcastle-on-Tyne	186,300	311	6	204	10	167	1	230	9	912	26
	Tynemouth -	46,588	47	6	41	6	38	1	38	1	164	14
	Carlisle - -	39,176	28	—	26	1	52	—	56	1	162	2
XI. Welsh.	Newport (Mon.) -	54,707	90	3	67	—	118	3	181	3	456	9
	Cardiff - -	128,915	126	2	151	4	262	10	332	12	871	28
	Merthyr Tydfil -	58,080	31	2	54	2	32	—	86	2	203	6
	Swansea - -	90,349	75	—	122	2	143	1	213	1	553	4
	Totals, 81 Districts	12,369,163	14,931	700	14,167	629	20,103	683	22,280	906	71,481	2,918

App. A. No. 16.

Compilation of Returns of Notified Infectious Diseases, and registered Deaths therefrom.

In Registration Divisions.	Urban Sanitary Districts.	Population (1891).	Diphtheria.									
			1st Quarter.		2nd Quarter.		3rd Quarter.		4th Quarter.		Total for 1896.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
I.	London - - (*Admin. Co.*)	4,232,118	3,106	683	2,850	566	3,499	649	3,918	85	13,373	2,683
II. South-Eastern.	Croydon - -	102,695	37	5	43	8	56	9	37	7	173	29
	Dover - -	33,300	5	2	3	2	9	3	14	2	31	9
	Eastbourne -	34,969	8	—	6	—	9	—	21	5	44	5
	Bournemouth -	37,781	6	—	7	3	3	1	13	2	29	6
	Southampton -	65,325	9	2	4	2	11	1	26	3	50	8
	Reading - -	60,054	3	2	6	2	9	—	7	2	25	6
III. South Midland.	Willesden -	61,265	49	11	43	8	26	1	49	10	167	30
	Hornsey -	44,205	25	2	15	1	33	4	23	5	96	12
	Tottenham -	71,343	65	8	14	3	35	9	68	10	182	30
	Oxford - -	45,742	12	3	16	—	7	2	13	—	48	5
	Northampton -	61,012	3	—	2	—	1	1	2	1	8	2
	Cambridge -	36,983	1	—	3	—	2	—	3	—	9	—
IV. Eastern.	Leyton -	63,056	48	6	37	7	47	9	66	7	198	29
	Walthamstow -	46,346	25	5	34	11	28	9	33	5	120	30
	West Ham -	204,903	192	37	217	42	221	39	274	69	904	187
	Colchester -	34,559	16	1	8	—	5	1	16	5	45	7
	Norwich -	100,970	36	11	18	5	14	2	24	6	92	24
V. South-Western.	Exeter - -	37,404	9	2	3	—	2	—	2	—	16	2
	Plymouth -	84,248	4	5	3	2	12	3	18	3	37	13
	Devonport -	54,803	6	4	4	1	10	5	9	4	29	14
	Bath - -	51,844	14	3	18	3	9	3	35	8	76	17
VI. West Midland.	Bristol - -	221,578	65	14	66	7	51	7	68	9	250	37
	St. George -	36,718	16	3	12	3	8	2	30	7	66	15
	Gloucester -	39,444	3	1	17	2	43	13	65	22	128	38
	Burton-on-Trent	46,047	35	8	45	10	40	7	29	7	149	32
	Wolverhampton	82,662	108	20	99	14	84	9	62	10	353	53
	Walsall - -	71,789	6	2	7	2	10	3	18	5	41	12
	West Bromwich	59,474	2	1	6	3	10	1	9	6	27	11
	Worcester -	42,908	16	6	59	16	121	15	114	14	313	51
	Smethwick -	36,170	6	—	6	—	9	3	10	1	31	4
	Birmingham -	478,113	262	85	278	71	302	61	267	53	1,109	270
	Aston Manor -	68,639	80	16	38	9	44	11	52	15	214	51
	Coventry -	52,724	2	1	3	1	5	—	6	1	16	3
VII. North Midland.	Leicester	174,624	38	17	48	14	26	10	48	23	160	64
	Grimsby	51,934	39	11	23	5	13	1	12	4	87	21
	Nottingham -	213,877	16	4	19	3	6	—	19	6	60	13
	Derby - -	94,146	14	4	13	1	11	4	9	1	47	10

Compilation of Returns of Notified Infectious Diseases, and registered Deaths therefrom.

In Registration Divisions.	Urban Sanitary Districts.	Population (1891).	Diphtheria—*continued.* 1st Quarter. Cases.	1st Quarter. Deaths.	2nd Quarter. Cases.	2nd Quarter. Deaths.	3rd Quarter. Cases.	3rd Quarter. Deaths.	4th Quarter. Cases.	4th Quarter. Deaths.	Total for 1896. Cases.	Total for 1896. Deaths.
VIII. North-Western.	Stockport - -	70,263	14	4	4	3	12	3	6	2	36	12
	Macclesfield -	36,000	90	22	47	10	62	16	44	13	243	61
	Birkenhead -	99,857	43	7	27	5	18	9	26	1	114	22
	Liverpool - -	629,443	110	44	97	30	106	36	142	47	455	157
	St. Helens (Lancs.)	71,288	16	4	14	5	16	3	15	5	61	17
	Southport - -	41,406	10	1	7	2	4	1	7	1	28	5
	Wigan - -	55,013	3	1	3	1	2	1	2	—	10	3
	Warrington -	52,743	2	1	3	1	—	—	2	—	7	2
	Bolton - -	115,002	12	3	7	4	4	5	7	2	30	14
	Bury (Lancs.) -	57,212	10	6	4	3	6	4	7	3	27	16
	Salford - -	198,139	41	16	30	6	45	10	41	17	157	49
	Manchester -	505,368	93	25	38	24	47	14	41	18	219	81
	Ashton-under-Lyne	40,463	1	—	5	—	4	—	6	3	16	3
	Oldham - -	131,463	25	11	11	8	10	5	17	11	63	35
	Accrington - -	38,603	8	1	4	—	2	—	26	1	40	2
	Burnley - -	87,016	39	11	32	13	32	9	45	15	148	48
	Blackburn - -	120,064	1	—	5	2	8	5	8	3	22	10
	Darwen - -	34,192	3	3	—	—	1	—	1	—	5	3
	Preston - -	107,573	13	5	10	3	3	1	8	3	34	12
	Barrow-in-Furness	51,712	13	3	6	2	13	4	12	—	44	9
IX. Yorkshire.	Huddersfield -	95,420	17	8	10	7	8	2	8	4	43	21
	Halifax - -	89,832	14	13	7	—	4	2	13	6	38	21
	Bradford - -	216,361	19	10	8	3	7	2	7	2	41	17
	Leeds - -	367,505	37	17	32	9	20	12	31	11	120	49
	Wakefield - -	33,146	5	1	8	1	4	3	3	—	20	5
	Barnsley - -	35,427	3	4	11	2	14	3	17	2	45	11
	Sheffield - -	324,243	37	14	31	19	16	4	30	19	114	56
	Rotherham - -	42,061	3	1	8	2	6	1	3	—	20	4
	York - -	67,004	10	2	3	—	4	—	3	—	20	2
	Hull - - -	200,044	36	16	54	12	24	10	44	13	158	51
	Middlesbrough -	75,532	10	3	7	5	8	6	7	5	32	19
X. Northern.	Darlington - -	38,060	1	—	2	—	4	2	2	2	9	4
	Stockton-on-Tees -	49,705	11	6	11	4	8	2	4	1	34	13
	West Hartlepool -	42,710	2	1	2	—	—	—	4	2	8	3
	Sunderland -	131,015	8	3	10	2	1	—	6	3	25	8
	South Shields -	78,391	9	3	4	2	7	2	11	3	31	10
	Newcastle-on-Tyne	186,300	74	17	29	7	27	5	32	10	162	39
	Tynemouth -	46,588	7	4	2	1	4	3	8	2	21	10
	Carlisle - -	39,176	10	4	4	—	5	3	3	—	22	7
XI. Welsh.	Newport (Mon.) -	54,707	11	5	1	1	11	3	23	5	46	14
	Cardiff - -	128,915	61	7	60	11	71	15	109	29	301	62
	Merthyr Tydfil -	58,080	4	1	12	7	19	11	37	17	72	36
	Swansea -	90,349	7	—	8	3	7	3	8	4	30	10
	Totals, 81 Districts	12,369,163	5,330	1,293	4,771	1,047	5,508	1,118	6,565	1,408	21,974	4,866

In Registration Divisions.	Urban Sanitary Districts.	Population (1891).	"Fever." 1st Quarter. Notifications. Typhus.	Enteric.	Continued.	Total.	Deaths.	2nd Quarter. Notifications. Typhus.	Enteric.	Continued.	Total.	Deaths.
I.	London - - - (*Administrative County*)	4,232,118	1	668	21	690	142	—	501	20	521	84
II. South-Eastern.	Croydon - - -	102,695	—	13	—	13	4	—	12	1	13	1
	Dover - - - -	33,300	—	6	—	6	3	—	4	1	5	2
	Eastbourne - - -	34,969	—	2	—	2	—	—	2	—	2	—
	Bournemouth - -	37,781	—	—	—	—	—	—	2	—	2	1
	Southampton - -	65,325	—	9	—	9	6	—	19	—	19	3
	Reading - - -	60,054	—	5	—	5	—	—	8	—	8	—
III. South Midland.	Willesden - - -	61,265	—	14	—	14	3	—	10	1	11	2
	Hornsey - - - -	44,205	—	4	1	5	2	—	3	—	3	1
	Tottenham - - -	71,343	—	31	—	31	5	—	29	—	29	1
	Oxford - - -	45,742	—	1	—	1	—	—	2	—	2	—
	Northampton - -	61,012	—	4	—	4	2	—	3	—	3	—
	Cambridge - - -	36,983	—	8	—	8	2	—	6	—	6	1
IV. Eastern.	Leyton - - -	63,056	—	14	5	19	2	—	13	2	15	3
	Walthamstow - -	46,346	—	63	—	63	7	—	44	1	45	3
	West Ham - - -	204,903	—	88	—	88	11	—	32	1	33	9
	Colchester - - -	34,559	—	5	3	8	—	—	2	—	2	1
	Norwich - - -	100,970	—	44	—	44	5	—	51	—	51	6
V. South-Western.	Exeter - - -	37,404	—	9	—	9	1	—	20	2	22	5
	Plymouth - - -	84,248	—	10	—	10	2	—	5	—	5	2
	Devonport - - -	54,803	—	5	—	5	3	—	13	—	13	3
	Bath - - - -	51,844	—	8	—	8	1	—	2	—	2	1
VI. West Midland.	Bristol - - -	221,578	—	34	1	35	3	—	32	2	34	8
	St. George - - -	36,718	—	4	1	5	1	—	8	—	8	1
	Gloucester - - -	39,444	—	4	—	4	3	—	1	—	1	1
	Burton-on-Trent - -	46,047	—	4	1	5	2	—	2	—	2	—
	Wolverhampton - -	82,662	—	36	2	38	10	—	36	1	37	10
	Walsall - - -	71,789	—	18	—	18	4	—	16	—	16	2
	West Bromwich - -	59,474	—	30	—	30	6	—	19	1	20	4
	Worcester - - -	42,908	—	2	—	2	1	—	2	—	2	—
	Smethwick - - -	36,170	—	3	1	4	3	—	4	—	4	2
	Birmingham - - -	478,113	—	113	2	115	26	—	106	1	107	19
	Aston Manor - - -	68,639	—	21	—	21	2	—	9	1	10	2
	Coventry - - -	52,724	—	14	4	18	1	—	3	—	3	1
VII. North Midland.	Leicester - - -	174,624	—	62	—	62	8	—	37	—	37	8
	Grimsby - - -	51,934	—	29	4	33	5	—	25	1	26	4
	Nottingham - - -	213,877	—	135	—	135	27	—	66	—	66	13
	Derby - - -	94,146	—	34	—	34	10	—	12	—	12	12

"FEVER"—*continued.*

3rd Quarter.					4th Quarter.					Totals for 1896.					Urban Sanitary Districts.
Notifications.					Notifications.					Notifications.					
Typhus.	Enteric.	Continued.	Total.	Deaths.	Typhus.	Enteric.	Continued.	Total.	Deaths.	Typhus.	Enteric.	Continued.	Grand Total.	Deaths.	
5	981	30	1,016	169	—	1,050	33	1,083	213	6	3,200	104	3,310	608	London. (*Admin. Co.*)
1	67	9	77	7	—	17	2	19	6	1	109	12	122	18	Croydon.
—	—	—	—	—	—	4	—	4	—	—	14	1	15	5	Dover.
—	38	—	38	2	—	42	—	42	7	—	84	—	84	9	Eastbourne.
—	2	—	2	1	—	3	—	3	1	—	7	—	7	3	Bournemouth.
—	32	—	32	4	—	19	—	19	—	—	79	—	79	13	Southampton.
—	5	—	5	—	—	3	—	3	—	—	21	—	21	—	Reading.
—	19	—	19	3	—	10	—	10	2	—	53	1	54	10	Willesden.
—	11	—	11	—	—	12	—	12	3	—	30	1	31	6	Hornsey.
—	32	—	32	4	—	20	1	21	4	—	112	1	113	14	Tottenham.
—	8	—	8	2	—	14	—	14	2	—	25	—	25	4	Oxford.
—	3	—	3	1	—	10	—	10	2	—	20	—	20	5	Northampton.
—	18	—	18	2	—	9	—	9	2	—	41	—	41	7	Cambridge.
—	30	5	35	1	—	28	—	28	3	—	85	12	97	9	Leyton.
—	57	—	57	6	—	27	—	27	3	—	191	1	192	19	Walthamstow.
—	172	3	175	26	—	86	2	88	15	—	378	6	384	61	West Ham.
—	1	—	1	1	—	7	—	7	2	—	15	3	18	4	Colchester.
—	67	—	67	6	—	34	—	34	4	—	196	—	196	21	Norwich.
—	25	—	25	6	—	9	—	9	1	—	63	2	65	13	Exeter.
—	7	—	7	2	—	6	—	6	—	—	28	—	28	6	Plymouth.
—	13	—	13	2	—	4	—	4	1	—	35	—	35	9	Devonport.
—	6	—	6	2	—	6	—	6	1	—	22	—	22	5	Bath.
—	21	1	22	2	—	21	—	21	5	—	108	4	112	18	Bristol.
—	2	—	2	—	—	8	1	9	1	—	22	2	24	3	St. George.
—	7	—	7	—	—	6	—	6	—	—	18	—	18	4	Gloucester.
—	18	—	18	2	—	12	—	12	1	—	36	1	37	5	Burton-on-Trent.
—	51	2	53	11	—	14	2	16	5	—	137	7	144	36	Wolverhampton.
—	19	—	19	4	—	16	—	16	1	—	69	—	69	11	Walsall.
—	22	—	22	5	—	14	—	14	5	—	85	1	86	20	West Bromwich.
—	12	—	12	3	—	2	—	2	—	—	18	—	18	4	Worcester.
—	6	4	10	—	—	14	—	14	3	—	27	5	32	8	Smethwick.
—	130	1	131	25	—	140	2	142	37	—	489	6	495	107	Birmingham.
—	26	—	26	4	—	26	—	26	7	—	82	1	83	15	Aston Manor.
—	18	2	20	3	—	23	1	24	7	—	58	7	65	12	Coventry.
—	84	—	84	9	—	103	—	103	15	—	286	—	286	40	Leicester.
—	55	—	55	5	—	23	2	25	3	—	132	7	139	17	Grimsby.
—	66	—	66	13	—	166	—	166	26	—	433	—	433	79	Nottingham.
—	36	—	36	4	—	25	—	25	5	—	107	—	107	21	Derby.

In Registration Divisions.	Urban Sanitary Districts.	Population (1891).	"FEVER"—*continued.* 1st Quarter. Notifications. Typhus.	Enteric.	Continued.	Total.	Deaths.	2nd Quarter. Notifications. Typhus.	Enteric.	Continued.	Total.	Deaths.
VIII. North-Western.	Stockport	70,263	—	6	4	10	4	—	9	—	9	3
	Macclesfield	36,000	—	2	—	2	1	—	4	—	4	—
	Birkenhead	99,857	—	51	—	51	5	—	24	—	24	7
	Liverpool	629,443	37	145	14	196	31	151	261	38	450	50
	St. Helens (Lancs.)	71,288	—	23	—	23	4	—	19	1	20	5
	Southport	41,406	—	8	1	9	—	—	1	—	1	1
	Wigan	55,013	16	18	1	35	5	1	18	—	19	2
	Warrington	52,743	—	11	—	11	2	—	3	1	4	1
	Bolton	115,002	—	55	—	55	15	—	35	—	35	6
	Bury (Lancs.)	57,212	—	7	1	8	2	—	3	—	3	—
	Salford	198,139	3	57	5	65	17	1	75	2	78	16
	Manchester	505,368	—	125	—	125	30	—	130	—	130	31
	Ashton-under-Lyne	40,463	—	16	1	17	5	—	14	1	15	5
	Oldham	131,463	1	22	—	23	3	—	29	—	29	4
	Accrington	38,603	—	12	—	12	2	—	15	—	15	2
	Burnley	87,016	—	24	—	24	4	—	24	—	24	3
	Blackburn	120,064	—	28	—	28	9	—	29	—	29	10
	Darwen	34,192	—	16	—	16	3	—	10	1	11	2
	Preston	107,573	—	26	—	26	7	—	15	—	15	5
	Barrow-in-Furness	51,712	—	11	5	16	2	—	7	4	11	4
IX. Yorkshire.	Huddersfield	95,420	—	5	—	5	—	—	15	—	15	3
	Halifax	89,832	—	17	—	17	3	—	31	1	32	8
	Bradford	216,361	—	27	—	27	8	—	19	—	19	6
	Leeds	367,505	—	60	1	61	15	—	40	1	41	11
	Wakefield	33,146	—	5	—	5	2	—	4	—	4	2
	Barnsley	35,427	—	21	—	21	4	—	4	—	4	—
	Sheffield	324,243	—	165	6	171	20	—	67	4	71	19
	Rotherham	42,061	—	20	—	20	2	—	14	—	14	1
	York	67,004	—	7	—	7	—	—	14	—	14	2
	Hull	200,044	—	42	6	48	8	—	55	8	63	10
	Middlesbrough	75,532	—	75	2	77	20	—	45	—	45	5
X. Northern.	Darlington	38,060	—	5	—	5	2	—	2	1	3	—
	Stockton-on-Tees	49,705	—	24	3	27	—	—	14	3	17	1
	West Hartlepool	42,710	—	16	—	16	1	—	11	1	12	—
	Sunderland	131,015	—	27	9	36	8	—	31	4	35	3
	South Shields	78,391	—	27	5	32	4	—	24	1	25	6
	Newcastle-on-Tyne	186,300	—	37	4	41	6	—	28	2	30	8
	Tynemouth	46,588	—	5	—	5	4	—	7	—	7	—
	Carlisle	39,176	—	5	—	5	2	—	2	—	2	—
XI. Welsh.	Newport (Mon.)	54,707	—	10	1	11	2	—	6	2	8	—
	Cardiff	128,915	—	9	2	11	4	1	13	—	14	2
	Merthyr Tydfil	58,080	—	52	—	52	7	—	28	—	28	3
	Swansea	90,349	—	32	—	32	5	—	43	—	43	5
	Totals, 81 Districts	12,369,163	58	2,910	117	3,085	591	154	2,403	112	2,669	458

"FEVER"—*continued.*															
3rd Quarter.					4th Quarter.					Totals for 1896.					Urban Sanitary Districts.
Notifications.					Notifications.					Notifications.					
Typhus.	Enteric.	Continued.	Total.	Deaths.	Typhus.	Enteric.	Continued.	Total.	Deaths.	Typhus.	Enteric.	Continued.	Grand Total.	Deaths.	
—	30	2	32	7	—	39	3	42	8	—	84	9	93	22	Stockport.
—	11	—	11	3	—	6	—	6	—	—	23	—	23	4	Macclesfield.
—	33	—	33	6	—	40	3	43	8	—	148	3	151	26	Birkenhead.
59	361	18	438	54	55	329	19	403	76	302	1	89	1,487	206	Liverpool.
—	62	2	64	14	—	61	1	62	18	—	165	4	169	41	St. Helens (Lancs.).
—	8	—	8	1	—	2	—	2	1	—	19	1	20	3	Southport.
2	32	2	36	6	—	34	—	34	5	19	102	3	124	18	Wigan.
—	7	—	7	2	—	12	—	12	—	—	33	1	34	5	Warrington.
—	44	—	44	8	—	51	—	51	19	—	185	—	185	48	Bolton.
—	16	5	21	5	—	13	2	15	5	—	39	8	47	12	Bury (Lancs.).
—	81	3	84	15	—	88	6	94	23	4	301	16	321	71	Salford.
1	107	—	108	25	—	154	—	154	36	1	516	—	517	122	Manchester.
—	9	3	12	3	—	25	3	28	4	—	64	8	72	17	Ashton-under-Lyne.
1	27	—	28	4	—	44	—	44	12	2	122	—	124	23	Oldham.
—	9	—	9	1	—	17	1	18	5	—	53	1	54	10	Accrington.
—	23	—	23	2	—	36	—	36	4	—	107	—	107	13	Burnley.
—	37	—	37	7	—	53	—	53	8	—	147	—	147	34	Blackburn.
—	4	1	5	1	—	6	1	7	2	—	36	3	39	8	Darwen.
—	28	—	28	6	—	64	—	64	8	—	133	—	133	26	Preston.
—	8	2	10	4	—	11	5	16	4	—	37	16	53	14	Barrow-in-Furness.
—	32	—	32	6	—	18	—	18	4	—	70	—	70	13	Huddersfield.
—	9	—	9	2	—	48	1	49	7	—	105	2	107	20	Halifax.
—	35	—	35	5	—	71	2	73	9	—	152	2	154	28	Bradford.
36	185	4	225	33	6	146	3	155	28	42	431	9	482	87	Leeds.
—	18	—	18	3	—	27	—	27	4	—	54	—	54	11	Wakefield.
—	30	—	30	3	—	19	—	19	1	—	74	—	74	8	Barnsley.
—	227	4	231	37	—	181	3	184	25	—	640	17	657	101	Sheffield.
—	33	—	33	4	—	16	—	16	2	—	83	—	83	9	Rotherham.
—	50	4	54	6	—	26	—	26	5	—	97	4	101	13	York.
—	151	15	166	29	—	67	14	81	15	—	315	43	358	62	Hull.
—	25	1	26	5	—	39	2	41	8	—	184	5	189	38	Middlesbrough.
—	5	1	6	1	—	13	2	15	2	—	25	4	29	5	Darlington.
—	27	2	29	5	—	28	—	28	1	—	93	8	101	7	Stockton-on-Tees.
—	12	—	12	3	—	6	1	7	1	—	45	2	47	5	West Hartlepool.
1	111	20	132	23	—	76	23	99	19	1	245	56	302	53	Sunderland.
—	41	3	44	6	—	40	12	52	7	—	132	21	153	23	South Shields.
—	58	4	62	6	—	58	—	58	13	—	181	10	191	33	Newcastle-on-Tyne.
—	7	—	7	—	—	6	—	6	2	—	25	—	25	6	Tynemouth.
—	6	—	6	—	—	—	—	—	—	—	13	—	13	2	Carlisle.
—	18	3	21	5	—	12	—	12	2	—	46	6	52	9	Newport (Mon.)
—	24	4	28	2	—	28	1	29	5	1	74	7	82	13	Cardiff.
—	69	—	69	11	—	42	—	42	3	—	191	—	191	24	Merthyr Tydfil.
—	26	—	26	1	—	48	—	48	4	—	149	—	149	15	Swansea.
106	4,303	160	4,569	707	61	4,133	154	4,348	801	379	13,749	543	14,671	2,557	Totals, 81 Districts.

No. 16 (A).

TABLE showing, Week by Week, during the Year 1896, for each of the SANITARY AREAS within the
CASES of and REGISTERED DEATHS from the following DISEASES, together with
The Cases are copied from the Weekly Returns of Notifiable Diseases received by the Board from the Metropolitan

District	Sanitary Areas.	Population (1891).	SMALL-POX. Weekly Statement, 1st Quarter, 1896. Jan. 4. Cases.	Jan. 4. Deaths.	Jan. 11. Cases.	Jan. 11. Deaths.	Jan. 18. Cases.	Jan. 18. Deaths.	Jan. 25. Cases.	Jan. 25. Deaths.	Feb. 1. Cases.	Feb. 1. Deaths.	Feb. 8. Cases.	Feb. 8. Deaths.
	London - - - -	4,232,118	[a]7	—	12	3	13	—	9	—	16	—	6	—
	(*Administrative County*) -	- -	[b]5	—	*11*	—	*12*	—	*8*	—	*14*	—	*4*	—
W. District.	Kensington - -	166,308	1	—	—	—	2	—	1	—	—	—	—	—
	Fulham - - -	91,639	—	—	—	—	—	—	—	—	—	—	—	—
	Hammersmith - -	97,239	1	—	1	—	—	—	—	—	—	—	—	—
	Paddington - - -	117,846	2	—	—	—	—	—	—	—	—	—	2	—
	Chelsea - - -	96,253	—	—	—	—	—	—	—	—	—	—	—	—
	St. George, Hanover Sq.* -	78,599	—	—	—	—	—	—	—	—	—	—	—	—
	Westminster - -	55,539	—	—	—	—	—	—	1	—	—	—	—	—
	St. James, Westminster -	24,995	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Marylebone - -	142,404	—	—	—	—	—	—	—	—	—	—	—	—
	Hampstead - - -	68,416	—	—	—	—	—	—	—	—	—	—	—	—
	St. Pancras - - -	234,379	—	—	—	—	—	—	—	—	—	—	—	—
	Islington - - -	319,143	—	—	1	—	—	—	1	—	—	—	—	—
	St. Mary, Stoke Newington	30,936	—	—	—	—	—	—	1	—	1	—	—	—
	Hackney - - -	198,606	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	—	—	—	—	—	—	—	—
	St. Martin-in-the-Fields -	14,616	—	—	—	—	—	—	—	—	—	—	—	—
	Strand† - - -	25,217	—	—	—	—	—	—	—	—	—	—	—	—
	Holborn‡ - - -	34,043	—	—	—	—	—	—	—	—	—	—	—	—
	Clerkenwell - -	66,216	—	—	—	—	—	—	—	—	1	—	1	—
	St. Luke, Middlesex -	42,440	—	—	—	—	1	—	1	—	—	—	—	—
	London, City of § - -	37,583	—	—	—	—	—	—	—	—	1	—	—	—
E. District.	Shoreditch - - -	124,009	1	—	—	1	—	—	—	—	—	—	—	—
	Bethnal Green - -	129,132	—	—	—	—	—	—	—	—	—	—	—	—
	Whitechapel‖ - -	74,420	—	—	1	—	—	—	1	—	—	—	—	—
	St. George-in-the-East -	45,795	—	—	—	—	—	—	—	—	1	—	—	—
	Limehouse - - -	57,376	—	—	—	—	—	—	—	—	—	—	—	—
	Mile End Old Town -	107,592	—	—	—	—	—	—	—	—	—	—	—	—
	Poplar - - -	166,748	1	—	3	—	2	—	—	—	—	—	—	—
S. District.	St. Saviour, Southwark -	27,177	—	—	—	—	1	—	—	—	—	—	1	—
	St. George, Southwark -	59,712	—	—	1	—	—	—	—	—	1	—	—	—
	Newington - - -	115,804	—	—	—	—	—	—	—	—	—	—	—	—
	St. Olave, Southwark -	12,723	—	—	—	—	—	—	—	—	—	—	—	—
	Bermondsey - - -	84,682	—	—	2	—	—	—	—	—	1	—	—	—
	Rotherhithe - - -	39,255	—	—	2	—	—	—	—	—	6	—	—	—
	Lambeth - - -	275,203	1	—	—	1	4	—	—	—	—	—	1	—
	Battersea - - -	150,558	—	—	—	—	—	—	—	—	—	—	—	—
	Wandsworth - -	156,942	—	—	—	—	—	—	—	—	—	—	—	—
	Camberwell - - -	235,344	—	—	—	—	—	—	—	—	—	—	—	—
	Greenwich - - -	165,413	—	—	1	1	3	—	—	—	4	—	1	—
	Lewisham - - -	92,647	—	—	—	—	—	—	2	—	—	—	—	—
	Woolwich - - -	40,848	—	—	—	—	—	—	—	—	—	—	—	—
	Plumstead - - -	52,436	—	—	—	—	—	—	—	—	—	—	—	—
	Lee - - - -	36,103	—	—	—	—	—	—	—	—	—	—	—	—
	Port of London - -	—	—	—	—	—	—	—	1	—	—	—	—	—

[a] Totals of actual *notifications*.
[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

No. 16 (A).

ADMINISTRATIVE COUNTY of LONDON and for the COUNTY as a WHOLE, the NUMBER of NOTIFIED
QUARTERLY and ANNUAL SUMMARIES of these Data for each of the AREAS in question.
Asylums Board. The Deaths are extracted from the Weekly Returns compiled by the Registrar-General.]

SMALL-POX—*continued.*																
Weekly Statement, 1st Quarter, 1896—*continued.*														Totals for 1st Quarter, 1896.		Sanitary Areas.
Feb. 15.		Feb. 22.		Feb. 29.		March 7.		March 14.		March 21.		March 28.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
15	—	9	—	1	—	11	2	3	—	8	—	4	—	114	5	London.
9	—	*8*	—	*1*	—	*9*	—	*3*	—	*6*	—	*4*	—	*94*	—	(*Administrative County.*)
—	—	—	—	—	—	—	—	—	—	—	—	1	—	5	—	Kensington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Fulham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	Hammersmith.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	Paddington.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	Chelsea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George, Hanover Sq.*
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. James, Westminster.
—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	—	St. Marylebone.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hampstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Pancras.
—	—	3	—	—	—	8	—	1	—	—	—	—	—	14	—	Islington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	St. Mary, Stoke Newington.
—	—	—	—	—	—	1	—	—	—	4	—	—	—	5	—	Hackney.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Strand.†
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Holborn.‡
6	—	—	—	—	—	—	—	—	—	—	—	—	—	8	—	Clerkenwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	London, City of.§
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	Shoreditch.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Bethnal Green.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	3	—	Whitechapel.‖
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	St. George-in-the-East.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Limehouse.
—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	—	Mile End Old Town.
1	—	—	—	—	—	1	—	—	—	1	—	—	—	9	—	Poplar.
—	—	1	—	—	—	—	—	—	—	—	—	—	—	3	—	St. Saviour, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	3	—	St. George, Southwark.
1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Olave, Southwark.
2	—	—	—	—	—	—	—	—	—	—	—	—	—	5	—	Bermondsey.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	8	—	Rotherhithe.
—	—	4	—	1	—	1	1	1	—	1	—	—	—	14	2	Lambeth.
1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Battersea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Wandsworth.
1	—	—	—	—	—	—	—	—	—	1	—	—	—	2	—	Camberwell.
3	—	—	—	—	—	—	1	—	—	—	—	—	—	12	2	Greenwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	Lewisham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Woolwich.
—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	—	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lee.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).
§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

Sanitary Areas.		Population (1891).	Small-pox—*continued.* Weekly Statement, 2nd Quarter, 1896. April 4. Cases.	April 4. Deaths.	April 11. Cases.	April 11. Deaths.	April 18. Cases.	April 18. Deaths.	April 25. Cases.	April 25. Deaths.	May 2. Cases.	May 2. Deaths.	May 9. Cases.	May 9. Deaths.
	London	4,232,118	[a]2	—	3	—	5	—	11	—	4	2	4	—
	(*Administrative County*)	- -	[b]2	—	*3*	—	*4*	—	*9*	—	*4*	—	*3*	—
W. District.	Kensington	166,308	—	—	1	—	—	—	3	—	—	—	3	—
	Fulham	91,639	—	—	—	—	—	—	—	—	—	—	—	—
	Hammersmith	97,239	—	—	—	—	—	—	2	—	—	—	—	—
	Paddington	117,846	—	—	—	—	—	—	—	—	—	—	—	—
	Chelsea	96,253	—	—	—	—	—	—	—	—	—	—	—	—
	St. George, Hanover Sq.*	78,599	—	—	—	—	—	—	—	—	—	—	—	—
	Westminster	55,539	—	—	—	—	—	—	—	—	—	—	—	—
	St. James, Westminster	24,995	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Marylebone	142,404	—	—	1	—	—	—	—	—	—	—	—	—
	Hampstead	68,416	—	—	—	—	—	—	—	—	—	—	—	—
	St. Pancras	234,379	—	—	—	—	—	—	2	—	—	—	—	—
	Islington	319,143	—	—	—	—	—	—	—	—	—	—	—	—
	St. Mary, Stoke Newington	30,936	—	—	—	—	—	—	—	—	—	—	—	—
	Hackney	198,606	—	—	1	—	—	—	1	—	—	—	—	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	—	—	—	—	—	—	—	—
	St. Martin-in-the-Fields	14,616	—	—	—	—	—	—	2	—	—	—	—	—
	Strand†	25,217	—	—	—	—	—	—	—	—	—	—	—	—
	Holborn‡	34,043	—	—	—	—	—	—	—	—	1	1	—	—
	Clerkenwell	66,216	—	—	—	—	—	—	—	—	—	—	—	—
	St. Luke, Middlesex	42,440	—	—	—	—	—	—	—	—	—	—	—	—
	London, City of§	37,583	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Shoreditch	124,009	—	—	—	—	—	—	—	—	—	—	—	—
	Bethnal Green	129,132	—	—	—	—	—	—	—	—	—	—	—	—
	Whitechapel‖	74,420	—	—	—	—	2	—	—	—	—	—	—	—
	St. George-in-the-East	45,795	—	—	—	—	—	—	—	—	—	—	—	—
	Limehouse	57,376	—	—	—	—	—	—	—	—	—	—	—	—
	Mile End Old Town	107,592	—	—	—	—	—	—	—	—	—	—	—	—
	Poplar	166,748	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	St. Saviour, Southwark	27,177	—	—	—	—	—	—	—	—	—	—	—	—
	St. George, Southwark	59,712	—	—	—	—	—	—	—	—	—	—	—	—
	Newington	115,804	—	—	—	—	—	—	—	—	1	1	1	—
	St. Olave, Southwark	12,723	—	—	—	—	—	—	—	—	—	—	—	—
	Bermondsey	84,682	—	—	—	—	—	—	—	—	—	—	—	—
	Rotherhithe	39,255	—	—	—	—	—	—	—	—	—	—	—	—
	Lambeth	275,203	—	—	—	—	—	—	—	—	—	—	—	—
	Battersea	150,558	—	—	—	—	—	—	—	—	—	—	—	—
	Wandsworth	156,942	—	—	—	—	—	—	1	—	—	—	—	—
	Camberwell	235,344	—	—	—	—	—	—	—	—	—	—	—	—
	Greenwich	165,413	—	—	—	—	1	—	—	—	—	—	—	—
	Lewisham	92,647	—	—	—	—	—	—	—	—	—	—	—	—
	Woolwich	40,848	—	—	—	—	—	—	—	—	—	—	—	—
	Plumstead	52,436	2	—	—	—	—	—	—	—	1	—	—	—
	Lee	36,103	—	—	—	—	—	—	—	—	1	—	—	—
	Port of London	—	—	—	—	—	2	—	—	—	—	—	—	—

[a] Totals of actual *notifications.*
[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction f duplicate notifications.
* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

Small-pox—*continued.*																
Weekly Statement, 2nd Quarter, 1896—*continued.*														Totals for 2nd Quarter, 1896.		Sanitary Areas.
May 16.		May 23.		May 30.		June 6.		June 13.		June 20.		June 27.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
4	—	4	—	3	—	8	—	2	—	29	—	10	1	89	3	London.
4	—	*4*	—	*3*	—	*6*	—	*2*	—	*25*	—	*8*	—	*77*	—	(*Administrative County.*)
—	—	—	—	—	—	1	—	—	—	—	—	—	—	8	—	Kensington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Fulham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	Hammersmith.
—	—	—	—	—	—	—	—	—	—	2	—	—	1	2	1	Paddington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Chelsea.
—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	—	St. George, Hanover Sq.*
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. James, Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	St. Marylebone.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hampstead.
1	—	—	—	—	—	—	—	—	—	1	—	—	—	4	—	St. Pancras.
1	—	1	—	—	—	4	—	—	—	14	—	2	—	22	—	Islington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Mary, Stoke Newington.
—	—	1	—	—	—	—	—	—	—	—	—	—	—	3	—	Hackney.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Strand.†
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	Holborn.‡
—	—	1	—	—	—	—	—	—	—	2	—	—	—	3	—	Clerkenwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	—	—	—	—	2	—	2	—	London, City of.§
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Shoreditch.
—	—	—	—	2	—	—	—	—	—	—	—	—	—	2	—	Bethnal Green.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	Whitechapel.‖
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George-in-the-East.
—	—	1	—	—	—	—	—	—	—	2	—	2	—	5	—	Limehouse.
1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Mile End Old Town.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Poplar.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Saviour, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	1	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Olave, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Bermondsey.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Rotherhithe.
—	—	—	—	—	—	—	—	—	—	5	—	—	—	5	—	Lambeth.
—	—	—	—	—	—	—	—	2	—	—	—	3	—	5	—	Battersea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Wandsworth.
1	—	—	—	—	—	1	—	—	—	1	—	1	—	4	—	Camberwell.
—	—	—	—	—	—	1	—	—	—	1	—	—	—	3	—	Greenwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lewisham.
—	—	—	—	1	—	—	—	—	—	—	—	—	—	1	—	Woolwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Lee.
—	—	—	—	—	—	1	—	—	—	—	—	—	—	3	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

Sanitary Areas.		Population (1891).	SMALL-POX—*continued.* Weekly Statement, 3rd Quarter, 1896.											
			July 4.		July 11.		July 18.		July 25.		Aug. 1.		Aug. 8.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
London - - - -		4,232,118	a13	1	11	—	—	—	5	—	4	—	3	—
(*Administrative County*) -		- -	b12	—	11	—	—	—	4	—	4	—	3	—
W. District.	Kensington - - -	166,308	1	—	—	—	—	—	—	—	—	—	—	—
	Fulham - - -	91,639	—	—	—	—	—	—	—	—	—	—	—	—
	Hammersmith - -	97,239	—	—	—	—	—	—	—	—	—	—	—	—
	Paddington - - -	117,846	—	—	—	—	—	—	—	—	1	—	—	—
	Chelsea - - -	96,253	—	—	—	—	—	—	—	—	—	—	—	—
	St. George, Hanover Sq.* -	78,599	—	—	—	—	—	—	—	—	—	—	—	—
	Westminster - -	55,539	—	—	—	—	—	—	—	—	1	—	—	—
	St. James, Westminster -	24,995	2	—	1	—	—	—	1	—	—	—	—	—
N. District.	St. Marylebone - -	142,404	1	—	—	—	—	—	—	—	—	—	—	—
	Hampstead - - -	68,416	—	—	—	—	—	—	—	—	—	—	—	—
	St. Pancras - - -	234,379	—	—	1	—	—	—	—	—	—	—	—	—
	Islington - - -	319,143	2	1	6	—	—	—	3	—	2	—	1	—
	St. Mary, Stoke Newington	30,936	—	—	—	—	—	—	—	—	—	—	—	—
	Hackney - - -	198,606	—	—	—	—	—	—	—	—	—	—	1	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	—	—	—	—	—	—	—	—
	St. Martin-in-the-Fields -	14,616	—	—	—	—	—	—	—	—	—	—	—	—
	Strand† - - -	25,217	—	—	—	—	—	—	—	—	—	—	—	—
	Holborn‡ - - -	34,043	—	—	—	—	—	—	—	—	—	—	—	—
	Clerkenwell - - -	66,216	1	—	—	—	—	—	—	—	—	—	—	—
	St. Luke, Middlesex -	42,440	—	—	—	—	—	—	—	—	—	—	—	—
	London, City of § - -	37,583	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Shoreditch - - -	124,009	—	—	—	—	—	—	—	—	—	—	—	—
	Bethnal Green - -	129,132	—	—	—	—	—	—	—	—	—	—	—	—
	Whitechapel‖ - -	74,420	—	—	—	—	—	—	—	—	—	—	—	—
	St. George-in-the-East -	45,795	—	—	—	—	—	—	—	—	—	—	—	—
	Limehouse - - -	57,376	—	—	2	—	—	—	—	—	—	—	—	—
	Mile End Old Town -	107,592	—	—	—	—	—	—	—	—	—	—	—	—
	Poplar - - -	166,748	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	St. Saviour, Southwark -	27,177	—	—	—	—	—	—	—	—	—	—	—	—
	St. George, Southwark -	59,712	—	—	—	—	—	—	—	—	—	—	—	—
	Newington - - -	115,804	—	—	—	—	—	—	—	—	—	—	—	—
	St. Olave, Southwark -	12,723	—	—	—	—	—	—	—	—	—	—	—	—
	Bermondsey - - -	84,682	—	—	—	—	—	—	—	—	—	—	—	—
	Rotherhithe - - -	39,255	—	—	—	—	—	—	—	—	—	—	—	—
	Lambeth - - -	275,203	—	—	—	—	—	—	—	—	—	—	—	—
	Battersea - - -	150,558	—	—	1	—	—	—	—	—	—	—	1	—
	Wandsworth - -	156,942	—	—	—	—	—	—	—	—	—	—	—	—
	Camberwell - - -	235,344	6	—	—	—	—	—	1	—	—	—	—	—
	Greenwich - - -	165,413	—	—	—	—	—	—	—	—	—	—	—	—
	Lewisham - - -	92,647	—	—	—	—	—	—	—	—	—	—	—	—
	Woolwich - - -	40,848	—	—	—	—	—	—	—	—	—	—	—	—
	Plumstead - - -	52,436	—	—	—	—	—	—	—	—	—	—	—	—
	Lee - - - -	36,103	—	—	—	—	—	—	—	—	—	—	—	—
	Port of London - -	—	—	—	—	—	—	—	—	—	—	—	—	—

a Totals of actual *notifications.*
b Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

SMALL-POX—*continued.*

Weekly Statement, 3rd Quarter, 1896—*continued.*														Totals for 3rd Quarter, 1896.		Sanitary Areas.
Aug. 15.		Aug. 22.		Aug. 29.		Sept. 5.		Sept. 12.		Sept. 19.		Sept. 26.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
3	—	3	—	7	—	1	—	3	—	—	—	1	—	54	1	London.
3	—	*3*	—	*6*	—	*1*	—	*3*	—	—	—	*1*	—	*51*	—	(*Administrative County.*)
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Kensington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Fulham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hammersmith.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Paddington.
—	—	—	—	1	—	—	—	—	—	—	—	—	—	1	—	Chelsea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George, Hanover Sq.*
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	St. James, Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	St. Marylebone.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hampstead.
—	—	—	—	—	—	—	—	1	—	—	—	—	—	2	—	St. Pancras.
1	—	—	—	6	—	—	—	1	—	—	—	1	—	23	1	Islington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Mary, Stoke Newington.
—	—	1	—	—	—	—	—	—	—	—	—	—	—	2	—	Hackney.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Strand.†
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Holborn.‡
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Clerkenwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	London, City of.§
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Shoreditch.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Bethnal Green.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Whitechapel.‖
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George-in-the-East.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	Limehouse.
1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Mile End Old Town.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Poplar.
—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	—	St. Saviour, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George, Southwark.
1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Olave, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Bermondsey.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Rotherhithe.
—	—	1	—	—	—	1	—	—	—	—	—	—	—	2	—	Lambeth.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	Battersea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Wandsworth.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	7	—	Camberwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Greenwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lewisham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Woolwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lee.
—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).
§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

District	Sanitary Areas.	Population (1891).	Small-pox—continued. Weekly Statement, 4th Quarter, 1896. Oct. 3. Cases.	Oct. 3. Deaths.	Oct. 10. Cases.	Oct. 10. Deaths.	Oct. 17. Cases.	Oct. 17. Deaths.	Oct. 24. Cases.	Oct. 24. Deaths.	Oct. 31. Cases.	Oct. 31. Deaths.	Nov. 7. Cases.	Nov. 7. Deaths.	Nov. 14. Cases.	Nov. 14. Deaths.
	London - - - -	4,232,118	[a]—	—	1	—	—	—	—	—	1	—	—	—	—	—
	(*Administrative County*) -	- -	[b]—	—	*1*	—	—	—	—	—	*1*	—	—	—	—	—
W. District.	Kensington - - -	166,308	—	—	—	—	—	—	—	—	—	—	—	—	—	—
W. District.	Fulham - - -	91,639	—	—	1	—	—	—	—	—	1	—	—	—	—	—
W. District.	Hammersmith - -	97,239	—	—	—	—	—	—	—	—	—	—	—	—	—	—
W. District.	Paddington - - -	117,846	—	—	—	—	—	—	—	—	—	—	—	—	—	—
W. District.	Chelsea - - -	96,253	—	—	—	—	—	—	—	—	—	—	—	—	—	—
W. District.	St. George, Hanover Sq.* -	78,599	—	—	—	—	—	—	—	—	—	—	—	—	—	—
W. District.	Westminster -	55,539	—	—	—	—	—	—	—	—	—	—	—	—	—	—
W. District.	St. James, Westminster -	24,995	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Marylebone - -	142,404	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	Hampstead - - -	68,416	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Pancras - - -	234,379	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	Islington - - -	319,143	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Mary, Stoke Newington	30,936	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	Hackney - - -	198,606	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	St. Martin-in-the-Fields -	14,616	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	Strand† - - -	25,217	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	Holborn‡ - - -	34,043	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	Clerkenwell - - -	66,216	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	St. Luke, Middlesex -	42,440	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	London, City of§ - -	37,583	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Shoreditch - - -	124,009	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Bethnal Green - -	129,132	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Whitechapel‖ - -	74,420	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	St. George-in-the-East -	45,795	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Limehouse - - -	57,376	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Mile End Old Town -	107,592	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Poplar - - -	166,748	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	St. Saviour, Southwark -	27,177	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	St. George, Southwark -	59,712	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Newington - - -	115,804	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	St. Olave, Southwark -	12,723	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Bermondsey - - -	84,682	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Rotherhithe - - -	39,255	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Lambeth - - -	275,203	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Battersea - - -	150,558	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Wandsworth - -	156,942	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Camberwell - - -	235,344	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Greenwich - - -	165,413	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Lewisham - - -	92,647	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Woolwich - - -	40,848	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Plumstead - - -	52,436	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Lee - - - -	36,103	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Port of London - -	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

[a] Totals of actual *notifications.*
[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

Small-pox—*continued.*																		
Weekly Statement, 4th Quarter, 1896—*continued.*												Jan. 2, 1897.		Totals for 4th Quarter, 1896.		Grand Totals for Year 1896.		Sanitary Areas.
Nov. 21.		Nov. 28.		Dec. 5.		Dec. 12.		Dec. 19.		Dec. 26.								
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
—	—	—	—	1	—	1	—	—	—	—	—	1	—	5	—	262	9	London.
—	—	—	—	*1*	—	*1*	—	—	—	—	—	*1*	—	*5*	—	*227*	—	(*Administrative County.*)
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	14	—	Kensington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	2	—	Fulham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	Hammersmith.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7	1	Paddington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	Chelsea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	St. George, Hanover Sq.*
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	St. James, Westminster.
—	—	—	—	—	—	1	—	—	—	—	—	—	—	1	—	4	—	St. Marylebone.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hampstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6	—	St. Pancras.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	59	1	Islington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	St. Mary, Stoke Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10	—	Hackney.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Strand.†
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	Holborn.‡
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	12	—	Clerkenwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	London, City of.§
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	Shoreditch.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	Bethnal Green.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5	—	Whitechapel.‖
—	—	—	—	1	—	—	—	—	—	—	—	—	—	1	—	2	—	St. George-in-the-East.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7	—	Limehouse.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	Mile End Old Town.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	9	—	Poplar.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	St. Saviour, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	St. George, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	1	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Olave, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5	—	Bermondsey.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8	—	Rotherhithe.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	21	2	Lambeth.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8	—	Battersea.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	2	—	Wandsworth.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	13	—	Camberwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	15	2	Greenwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	Lewisham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Woolwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Lee.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).
§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

District	Sanitary Areas.	Population (1891).	Scarlet Fever. Weekly Statement, 1st Quarter, 1896. Jan. 4. Cases.	Jan. 4. Deaths.	Jan. 11. Cases.	Jan. 11. Deaths.	Jan. 18. Cases.	Jan. 18. Deaths.	Jan. 25. Cases.	Jan. 25. Deaths.	Feb. 1. Cases.	Feb. 1. Deaths.	Feb. 8. Cases.	Feb. 8. Deaths.
	London - - - - -	4,232,118	465	28	411	22	431	25	460	26	407	19	410	19
	(*Administrative County*) -	- -	*441*	—	*401*	—	*414*	—	*432*	—	*392*	—	*392*	—
W. District.	Kensington - - -	166,308	26	1	18	1	16	3	23	—	18	1	29	—
W. District.	Fulham - - -	91,639	2	1	6	—	5	2	13	—	4	1	6	1
W. District.	Hammersmith - -	97,239	16	1	14	1	13	1	11	1	7	2	14	—
W. District.	Paddington - - -	117,846	13	2	13	1	17	1	13	1	15	—	19	—
W. District.	Chelsea - - -	96,253	9	1	5	—	6	1	8	—	4	—	7	2
W. District.	St. George, Hanover Sq.* -	78,599	8	—	3	—	3	—	6	—	8	—	9	—
W. District.	Westminster - -	55,539	8	—	6	—	5	—	4	1	4	—	2	—
W. District.	St. James, Westminster -	24,995	6	—	1	—	3	—	—	1	2	—	1	—
N. District.	St. Marylebone - -	142,404	13	—	10	1	11	—	11	1	7	—	7	—
N. District.	Hampstead - - -	68,416	12	1	5	—	5	—	4	—	11	—	4	—
N. District.	St. Pancras - - -	234,379	15	2	15	—	17	3	32	1	31	1	13	—
N. District.	Islington - - -	319,143	22	2	24	—	30	2	28	1	40	—	14	1
N. District.	St. Mary, Stoke Newington	30,936	2	—	2	—	3	—	16	—	4	1	14	—
N. District.	Hackney - - -	198,606	35	—	22	—	34	3	22	1	17	—	21	1
Central District.	St. Giles and St. George, Bloomsbury.	39,782	2	—	2	—	3	—	4	—	4	—	2	1
Central District.	St. Martin-in-the-Fields -	14,616	2	—	2	—	—	—	1	—	1	—	2	—
Central District.	Strand† - - -	25,217	2	1	6	—	5	—	4	2	—	—	1	—
Central District.	Holborn‡ - - -	34,043	3	—	4	—	1	—	2	—	1	—	3	—
Central District.	Clerkenwell - - -	66,216	7	2	1	1	6	—	12	1	4	—	2	—
Central District.	St. Luke, Middlesex -	42,440	5	—	1	—	3	1	1	2	4	—	2	—
Central District.	London, City of§ - -	37,583	1	—	2	—	3	—	2	1	5	—	6	—
E. District.	Shoreditch - - -	124,009	14	2	15	1	9	—	16	1	9	1	21	3
E. District.	Bethnal Green - -	129,132	13	—	15	3	13	1	14	1	20	—	7	—
E. District.	Whitechapel‖ - -	74,420	14	2	8	—	8	—	16	—	10	—	8	—
E. District.	St. George-in-the-East -	45,795	8	—	12	2	8	—	16	1	8	—	8	—
E. District.	Limehouse - - -	57,376	7	—	1	—	6	—	7	—	4	—	6	—
E. District.	Mile End Old Town -	107,592	11	1	12	—	20	—	11	—	5	—	13	—
E. District.	Poplar - - -	166,748	31	—	15	1	30	1	17	1	21	2	15	2
S. District.	St. Saviour, Southwark -	27,177	1	—	—	—	2	—	2	—	2	—	—	—
S. District.	St. George, Southwark -	59,712	2	1	2	1	4	—	1	1	2	—	8	—
S. District.	Newington - - -	115,804	6	—	14	1	10	1	7	—	8	—	15	—
S. District.	St. Olave, Southwark -	12,723	—	—	3	1	3	—	2	—	—	—	—	—
S. District.	Bermondsey - -	84,682	7	1	7	2	5	1	9	—	11	—	10	—
S. District.	Rotherhithe - - -	39,255	3	1	7	—	7	—	3	—	9	—	5	—
S. District.	Lambeth - - -	275,203	34	—	29	—	25	2	26	4	27	4	28	1
S. District.	Battersea - - -	150,558	24	1	22	1	23	1	22	—	19	2	31	2
S. District.	Wandsworth - -	156,942	21	—	13	1	9	—	16	—	12	—	6	1
S. District.	Camberwell - - -	235,344	25	2	27	2	31	1	18	2	19	2	8	1
S. District.	Greenwich - - -	165,413	14	—	19	1	11	—	19	—	10	1	16	2
S. District.	Lewisham - - -	92,647	5	1	12	—	11	—	12	1	7	—	9	—
S. District.	Woolwich - - -	40,848	2	—	1	—	—	—	—	—	5	1	5	—
S. District.	Plumstead - - -	52,436	9	1	10	—	6	—	6	—	6	—	8	1
S. District.	Lee - - - -	36,103	5	1	5	—	1	—	3	—	2	—	4	—
S. District.	Port of London - -	—	—	—	—	—	—	—	—	—	—	—	1	—

[a] Totals of actual *notifications*.
[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
*Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

Scarlet Fever—*continued.*																
Weekly Statement, 1st Quarter, 1896—*continued.*														Totals for 1st Quarter, 1896.		Sanitary Areas.
Feb. 15.		Feb. 22.		Feb 29.		March 7.		March 14.		March 21.		March 28.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
392	23	325	13	328	20	331	15	331	21	365	16	316	17	4,972	264	London.
381	—	*313*	—	*317*	—	*323*	—	*314*	—	*353*	—	*305*	—	*4,778*	—	(*Administrative County.*)
24	1	24	—	12	3	8	1	23	1	17	—	14	—	252	12	Kensington.
1	1	5	—	5	—	4	1	4	—	5	2	4	—	64	9	Fulham.
2	1	6	—	12	—	6	—	5	—	7	1	2	1	115	9	Hammersmith.
20	1	6	1	9	—	8	—	7	1	8	—	10	—	158	8	Paddington.
6	—	6	1	6	—	15	1	2	—	4	—	9	—	87	6	Chelsea.
7	—	3	—	2	—	2	—	2	—	4	—	4	—	61	—	St. George, Hanover Sq.*
6	—	—	—	3	—	2	—	10	1	4	—	2	—	56	2	Westminster.
3	1	2	—	—	—	—	—	1	—	3	—	1	—	23	2	St. James, Westminster.
5	—	7	—	8	1	5	—	12	—	11	—	13	—	120	3	St. Marylebone.
3	—	4	—	2	—	4	—	8	—	9	—	9	—	80	1	Hampstead.
21	—	26	3	14	—	12	—	17	3	23	1	14	2	250	16	St. Pancras.
32	1	24	2	21	1	19	—	18	—	18	—	28	—	318	10	Islington.
1	—	1	—	3	—	4	—	2	—	3	—	1	—	56	1	St. Mary, Stoke Newington.
31	—	14	—	26	1	27	—	19	1	14	—	19	1	301	8	Hackney.
—	—	1	—	1	—	—	—	1	—	2	—	3	—	25	1	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	2	—	—	—	1	—	—	—	11	—	St. Martin-in-the-Fields.
1	—	1	—	1	—	—	—	3	—	3	—	3	1	30	4	Strand.†
—	—	3	—	7	—	5	—	2	—	2	—	2	—	35	—	Holborn.‡
6	—	4	—	6	—	13	—	4	—	9	—	4	—	78	4	Clerkenwell.
—	—	4	—	2	—	2	—	3	1	1	—	—	—	28	4	St. Luke, Middlesex.
3	—	8	—	4	—	4	1	—	—	1	—	1	—	40	2	London, City of.§
14	3	6	—	7	2	12	2	7	1	9	—	6	1	145	17	Shoreditch.
13	—	11	—	11	1	10	1	13	1	14	—	11	2	165	10	Bethnal Green.
9	—	5	—	6	—	7	—	8	1	4	—	8	—	111	3	Whitechapel.‖
7	—	8	—	11	—	2	1	9	1	6	1	3	1	106	7	St. George-in-the-East.
11	—	9	—	8	—	2	—	8	1	6	—	3	—	78	1	Limehouse.
10	4	10	2	7	1	8	1	8	1	18	2	11	1	144	13	Mile End Old Town.
11	—	12	1	17	—	14	1	23	1	12	—	13	1	231	11	Poplar.
2	—	1	—	—	—	1	—	6	—	2	—	6	—	25	—	St. Saviour, Southwark.
9	1	5	1	8	—	8	1	4	3	3	—	4	—	60	9	St. George, Southwark.
9	1	6	—	6	—	12	1	10	—	8	—	10	1	121	5	Newington.
—	1	3	1	—	—	1	1	1	—	6	—	—	—	19	4	St. Olave, Southwark.
9	—	1	—	5	1	3	—	7	—	2	—	4	2	80	7	Bermondsey.
4	1	14	—	2	1	2	—	3	—	—	—	6	—	65	3	Rotherhithe.
26	4	18	1	21	1	30	—	12	2	24	2	16	—	316	21	Lambeth.
22	—	18	—	10	3	14	—	19	—	12	2	12	—	248	12	Battersea.
11	—	6	—	17	—	16	1	16	—	17	2	14	—	174	5	Wandsworth.
20	1	13	—	20	1	21	1	13	1	15	—	13	1	243	15	Camberwell.
18	1	22	—	10	2	10	—	11	—	31	1	20	—	211	8	Greenwich.
3	—	1	—	9	—	5	—	4	—	14	—	5	—	97	2	Lewisham.
1	—	1	—	3	—	2	—	2	—	5	1	1	1	28	3	Woolwich.
7	—	5	—	6	1	9	—	2	—	5	1	5	1	84	5	Plumstead.
4	—	—	—	—	—	—	—	2	—	3	—	2	—	31	1	Lee.
—	—	1	—	—	—	—	—	—	—	—	—	—	—	2	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).
§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

District	Sanitary Areas.	Population (1891).	Scarlet Fever—*continued.* Weekly Statement, 2nd Quarter, 1896. April 4. Cases.	April 4. Deaths.	April 11. Cases.	April 11. Deaths.	April 18. Cases.	April 18. Deaths.	April 25. Cases.	April 25. Deaths.	May 2. Cases.	May 2. Deaths.	May 9. Cases.	May 9. Deaths.
	London - - - -	4,232,118	[a]265	27	339	10	306	11	326	13	330	10	332	11
	(*Administrative County*) -	- -	[b]*258*	—	*330*	—	*287*	—	*308*	—	*318*	—	*322*	—
W. District.	Kensington - - -	166,308	10	—	7	—	15	1	10	1	11	—	8	—
W. District.	Fulham - - -	91,639	3	—	2	—	3	—	7	—	17	2	7	—
W. District.	Hammersmith - -	97,239	8	—	4	—	5	—	11	—	4	—	6	—
W. District.	Paddington - - -	117,846	7	1	14	—	14	—	6	—	7	—	2	—
W. District.	Chelsea - - -	96,253	5	—	11	—	14	2	3	1	5	—	13	—
W. District.	St. George, Hanover Sq.* -	78,599	5	—	5	—	4	1	3	—	9	—	3	—
W. District.	Westminster - -	55,539	1	2	6	1	1	—	3	—	5	—	4	—
W. District.	St. James, Westminster -	24,995	3	—	—	—	—	—	2	—	1	—	1	—
N. District.	St. Marylebone - -	142,404	14	—	11	1	5	1	16	—	12	2	17	—
N. District.	Hampstead - - -	68,416	4	—	5	1	4	—	7	—	8	—	3	—
N. District.	St. Pancras - -	234,379	15	1	15	1	10	—	24	—	12	—	10	2
N. District.	Islington - - -	319,143	14	1	19	—	19	—	20	—	28	1	30	1
N. District.	St. Mary, Stoke Newington	30,936	2	2	2	—	1	—	2	—	2	—	4	1
N. District.	Hackney - - -	198,606	10	2	47	1	21	—	14	1	18	1	27	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	1	—	1	—	1	—	1	—	—	—	1	—
Central District.	St. Martin-in-the-Fields -	14,616	—	—	1	—	—	—	—	—	2	—	1	—
Central District.	Strand† - - -	25,217	2	—	—	—	—	—	3	—	—	—	2	—
Central District.	Holborn‡ - - -	34,043	3	—	2	—	—	—	—	—	3	—	2	—
Central District.	Clerkenwell - - -	66,216	6	1	4	—	8	1	5	—	3	—	2	—
Central District.	St. Luke, Middlesex -	42,440	3	1	2	—	2	—	1	—	—	—	3	—
Central District.	London, City of§ - -	37,583	2	—	3	—	—	—	4	—	6	—	3	—
E. District.	Shoreditch - - -	124,009	5	1	5	1	8	—	3	—	8	—	8	1
E. District.	Bethnal Green - -	129,132	8	2	9	—	11	—	21	—	20	—	18	—
E. District.	Whitechapel‖ - -	74,420	4	1	10	—	7	—	5	—	12	—	10	—
E. District.	St. George-in-the-East -	45,795	3	—	4	—	8	—	7	—	9	—	5	—
E. District.	Limehouse - - -	57,376	2	1	3	—	5	—	4	—	5	—	4	—
E. District.	Mile End Old Town -	107,592	10	1	7	—	6	1	8	—	5	—	9	—
E. District.	Poplar - - -	166,748	7	1	9	2	8	—	14	—	11	—	10	1
S. District.	St. Saviour, Southwark -	27,177	3	1	2	—	5	—	3	—	—	—	1	—
S. District.	St. George, Southwark -	59,712	3	—	9	—	1	—	1	—	5	—	3	1
S. District.	Newington - - -	115,804	6	—	12	—	11	2	15	1	12	—	10	—
S. District.	St. Olave, Southwark -	12,723	1	—	1	—	1	—	—	—	—	—	—	—
S. District.	Bermondsey - - -	84,682	7	—	3	—	4	—	4	—	3	1	8	—
S. District.	Rotherhithe - - -	39,255	5	1	7	—	1	—	8	1	3	—	4	—
S. District.	Lambeth - - -	275,203	19	—	18	2	20	—	9	1	14	1	16	—
S. District.	Battersea - - -	150,558	8	1	9	—	16	—	12	1	13	1	12	—
S. District.	Wandsworth - -	156,942	21	1	21	—	20	—	7	—	15	—	14	—
S. District.	Camberwell - - -	235,344	16	1	20	—	14	2	25	1	12	—	18	1
S. District.	Greenwich - - -	165,413	10	3	11	—	14	—	14	2	10	—	9	—
S. District.	Lewisham - - -	92,647	—	—	—	—	3	—	11	—	4	—	7	1
S. District.	Woolwich - - -	40,848	1	—	2	—	1	—	—	1	3	—	3	—
S. District.	Plumstead - - -	52,436	6	1	6	—	4	—	7	—	9	1	10	2
S. District.	Lee - - - -	36,103	1	—	10	—	11	—	6	2	4	—	4	—
S. District.	Port of London - -	—	1	—	—	—	—	—	—	—	—	—	—	—

[a] Totals of actual *notifications.*
[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

Scarlet Fever—*continued.* Weekly Statement, 2nd Quarter, 1896—*continued.* May 16. Cases.	May 16. Deaths.	May 23. Cases.	May 23. Deaths.	May 30. Cases.	May 30. Deaths.	June 6. Cases.	June 6. Deaths.	June 13. Cases.	June 13. Deaths.	June 20. Cases.	June 20. Deaths.	June 27. Cases.	June 27. Deaths.	Totals for 2nd Quarter, 1896. Cases.	Totals for 2nd Quarter, 1896. Deaths.	Sanitary Areas.
397	16	486	12	437	19	457	13	484	22	484	18	510	14	5,153	196	London.
373	—	*447*	—	*417*	—	*430*	—	*451*	—	*461*	—	*492*	—	*4,894*	—	(*Administrative County.*)
9	1	15	—	22	1	11	—	21	—	15	—	31	—	185	4	Kensington.
14	1	18	—	12	—	13	1	7	—	20	—	4	1	127	5	Fulham.
13	—	10	—	8	—	11	2	16	—	9	—	13	—	118	2	Hammersmith.
8	—	11	—	15	—	28	—	14	—	19	1	20	2	165	4	Paddington.
8	1	13	—	3	—	5	—	11	2	7	1	5	—	103	7	Chelsea.
8	—	2	—	11	1	6	—	6	1	8	—	6	—	76	3	St. George, Hanover Sq.*
6	—	4	1	5	1	1	—	4	—	3	—	4	—	47	5	Westminster.
—	—	5	—	1	1	—	—	3	—	1	—	—	—	17	1	St. James, Westminster.
19	—	27	—	17	—	13	—	19	1	22	1	14	—	206	6	St. Marylebone.
7	—	1	—	4	—	5	—	4	—	4	—	5	—	61	1	Hampstead.
11	1	13	—	24	—	13	2	23	—	17	—	18	2	205	9	St. Pancras.
28	1	50	1	39	2	38	1	35	2	44	1	41	—	405	11	Islington.
6	—	—	—	3	—	5	1	2	—	5	—	2	—	36	4	St. Mary, Stoke Newington.
15	1	28	—	33	—	26	—	32	1	26	—	28	—	325	7	Hackney.
3	—	5	—	3	—	2	—	3	—	3	—	5	—	29	—	St. Giles and St. George, Bloomsbury.
—	—	1	—	2	—	—	1	—	—	1	—	1	—	9	1	St. Martin-in-the-Fields.
2	—	2	—	1	—	—	—	5	—	1	—	6	—	24	—	Strand.†
2	—	1	—	3	—	10	—	2	—	4	—	—	—	32	—	Holborn.‡
2	—	3	—	10	—	6	—	12	—	13	1	5	—	79	3	Clerkenwell.
2	—	6	—	3	—	3	—	1	—	3	—	6	—	35	1	St. Luke, Middlesex.
8	—	4	—	5	—	6	—	3	1	4	—	8	—	56	1	London, City of.§
6	—	9	—	5	1	9	—	9	—	6	—	9	2	90	6	Shoreditch.
33	2	38	1	14	1	45	—	22	3	24	1	25	1	288	11	Bethnal Green
7	—	8	—	5	1	13	—	16	—	23	—	17	—	137	2	Whitechapel.‖
12	—	12	—	11	—	5	—	15	—	3	1	10	—	104	1	St. George-in-the-East.
3	—	9	1	7	1	5	—	8	1	9	1	6	—	70	5	Limehouse.
10	1	9	—	12	1	14	1	17	—	12	—	14	—	133	5	Mile End Old Town.
12	—	22	—	22	—	15	2	18	—	23	1	15	—	189	7	Poplar.
1	—	2	—	—	—	3	—	1	1	5	1	3	—	29	3	St. Saviour, Southwark.
3	—	3	—	2	—	8	1	3	—	10	—	3	—	54	2	St. George, Southwark.
6	2	7	1	11	—	14	—	6	1	10	—	9	—	129	7	Newington.
2	—	2	—	6	—	1	—	2	—	1	—	1	—	18	—	St. Olave, Southwark.
11	1	9	—	5	—	11	—	10	1	6	1	10	—	91	4	Bermondsey.
6	—	—	—	2	—	2	—	4	—	2	—	1	—	45	2	Rotherhithe.
18	1	34	1	27	3	26	—	30	—	25	1	19	—	275	10	Lambeth.
22	—	17	1	18	1	35	—	12	1	18	1	23	1	215	8	Battersea.
17	1	22	1	11	3	11	—	21	—	14	1	12	1	206	8	Wandsworth.
22	—	23	2	14	1	17	—	28	—	32	—	33	3	274	11	Camberwell.
14	2	26	1	19	—	11	—	23	5	9	3	40	—	210	16	Greenwich.
6	—	4	—	9	—	—	—	8	—	7	—	7	1	66	2	Lewisham.
—	—	1	—	1	—	3	—	2	1	4	—	1	—	22	2	Woolwich.
11	—	7	—	11	—	5	1	4	—	8	1	11	—	99	6	Plumstead.
4	—	2	1	1	—	2	—	2	—	1	—	19	—	67	3	Lee.
—	—	1	—	—	—	—	—	—	—	—	—	—	—	2	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

§ Including Inner Temple (population, 96).

‖ Including Tower of London (population, 868).

District	Sanitary Areas.	Population (1891).	Scarlet Fever—*continued.* Weekly Statement, 3rd Quarter, 1896. July 4. Cases.	July 4. Deaths.	July 11. Cases.	July 11. Deaths.	July 18. Cases.	July 18. Deaths.	July 25. Cases.	July 25. Deaths.	Aug. 1. Cases.	Aug. 1. Deaths.	Aug. 8. Cases.	Aug. 8. Deaths.
	London - - - -	4,232,118	[a]597	15	649	11	569	20	632	17	704	24	632	15
	(*Administrative County*) -	- -	[b]*573*	—	*615*	—	*532*	—	*596*	—	*645*	—	*585*	—
W. District.	Kensington - - -	166,308	24	1	27	1	25	1	23	2	24	1	27	2
W. District.	Fulham - - -	91,639	5	—	19	—	19	—	8	—	14	1	21	1
W. District.	Hammersmith - -	97,239	18	—	9	—	9	1	10	—	12	1	10	—
W. District.	Paddington - - -	117,846	16	1	26	1	29	1	32	—	31	—	15	—
W. District.	Chelsea - - -	96,253	15	—	16	—	26	—	12	—	15	—	21	1
W. District.	St. George, Hanover Sq.* -	78,599	12	1	10	—	12	1	5	—	10	—	7	—
W. District.	Westminster - -	55,539	5	1	9	—	9	—	10	2	5	—	8	—
W. District.	St. James, Westminster -	24,995	1	—	1	—	3	—	1	—	4	—	3	—
N. District.	St. Marylebone - -	142,404	27	1	19	—	25	—	27	—	34	1	29	1
N. District.	Hampstead - - -	68,416	5	—	10	—	3	1	3	—	3	1	2	—
N. District.	St. Pancras - - -	234,379	22	—	31	1	25	1	39	—	31	2	35	—
N. District.	Islington - - -	319,143	47	2	48	1	44	2	41	3	54	1	55	1
N. District.	St. Mary, Stoke Newington	30,936	4	—	6	—	—	—	2	—	3	—	5	—
N. District.	Hackney - - -	198,606	42	2	36	—	27	—	26	1	41	—	27	2
Central District.	St. Giles and St. George, Bloomsbury.	39,782	6	—	6	1	4	1	5	—	6	1	4	—
Central District.	St. Martin-in-the-Fields -	14,616	2	—	5	—	2	1	2	—	1	—	1	—
Central District.	Strand† - - -	25,217	—	—	5	—	5	—	3	—	3	—	2	—
Central District.	Holborn‡ - - -	34,043	2	—	3	—	3	—	7	—	5	—	2	—
Central District.	Clerkenwell - - -	66,216	9	—	7	—	5	—	17	—	12	—	23	1
Central District.	St. Luke, Middlesex -	42,440	5	—	6	—	12	—	8	1	6	3	10	—
Central District.	London, City of§ -	37,583	12	—	15	—	8	1	12	—	8	—	3	—
E. District.	Shoreditch - - -	124,009	10	1	26	—	10	1	21	—	12	1	21	1
E. District.	Bethnal Green - -	129,132	32	—	28	—	20	1	21	—	32	—	31	1
E. District.	Whitechapel‖ - -	74,420	14	—	12	—	16	—	27	1	26	—	22	—
E. District.	St. George-in-the-East -	45,795	11	—	5	1	6	1	6	—	15	—	8	—
E. District.	Limehouse - - -	57,376	10	—	8	—	8	—	6	1	8	—	12	—
E. District.	Mile End Old Town -	107,592	11	—	27	—	17	2	16	—	34	3	19	—
E. District.	Poplar - - -	166,748	22	—	29	2	15	2	21	—	22	—	26	—
S. District.	St. Saviour, Southwark -	27,177	5	—	8	—	—	—	1	—	3	—	3	—
S. District.	St. George, Southwark -	59,712	7	—	12	—	6	—	16	—	7	—	9	—
S. District.	Newington - - -	115,804	32	1	13	—	19	—	19	—	15	—	9	—
S. District.	St. Olave, Southwark -	12,723	1	—	3	—	—	—	1	—	3	—	2	1
S. District.	Bermondsey - -	84,682	8	—	7	1	6	—	16	—	11	2	8	—
S. District.	Rotherhithe - -	39,255	3	—	4	—	5	—	3	1	4	—	1	—
S. District.	Lambeth - - -	275,203	48	2	35	—	40	—	45	2	52	2	48	2
S. District.	Battersea - - -	150,558	19	—	17	—	15	—	28	—	26	—	18	1
S. District.	Wandsworth - -	156,942	15	—	18	—	17	—	22	—	33	1	16	—
S. District.	Camberwell - - -	235,344	12	1	26	—	25	—	27	1	32	2	20	—
S. District.	Greenwich - - -	165,413	22	1	33	1	29	—	20	1	15	1	25	—
S. District.	Lewisham - - -	92,647	9	—	9	—	1	—	11	—	6	—	8	—
S. District.	Woolwich - - -	40,848	6	—	5	—	5	1	2	—	9	—	7	—
S. District.	Plumstead - - -	52,436	7	—	7	—	12	1	10	—	15	—	6	—
S. District.	Lee - - - -	36,103	14	—	3	1	2	—	—	1	2	—	3	—
S. District.	Port of London - -	—	—	—	—	—	—	—	—	—	—	—	—	—

[a] Totals of actual *notifications*.
[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

SCARLET FEVER—*continued.*

Aug. 15. Cases.	Aug. 15. Deaths.	Aug. 22. Cases.	Aug. 22. Deaths.	Aug. 29. Cases.	Aug. 29. Deaths.	Sept. 5. Cases.	Sept. 5. Deaths.	Sept. 12. Cases.	Sept. 12. Deaths.	Sept. 19. Cases.	Sept. 19. Deaths.	Sept. 26. Cases.	Sept. 26. Deaths.	Totals for 3rd Quarter, 1896. Cases.	Totals for 3rd Quarter, 1896. Deaths.	Sanitary Areas.
																Weekly Statement, 3rd Quarter, 1896—*continued.*
663	23	691	15	675	16	749	16	792	18	659	11	707	17	8,719	218	London.
626	—	*643*	—	*638*	—	*687*	—	*725*	—	*623*	—	*674*	—	*8,162*	—	(*Administrative County.*)
24	—	24	1	34	—	22	—	27	3	19	—	14	—	314	12	Kensington.
16	1	17	—	26	—	15	—	10	1	21	—	22	1	213	5	Fulham.
9	—	10	1	16	—	7	1	11	—	19	1	13	—	153	5	Hammersmith.
13	—	16	—	25	—	27	—	19	1	26	—	18	—	293	4	Paddington.
10	—	10	—	14	—	8	—	12	—	16	—	21	2	196	3	Chelsea.
12	1	8	—	3	—	4	—	24	1	4	—	5	—	116	4	St. George, Hanover Sq.*
7	—	9	—	3	—	7	—	6	—	2	—	1	—	81	3	Westminster.
3	—	—	—	2	—	5	—	—	—	1	—	1	—	25	—	St. James, Westminster.
36	—	25	1	29	1	33	3	37	1	25	1	29	—	375	10	St. Marylebone.
4	—	6	—	2	—	1	—	9	—	3	—	6	—	57	2	Hampstead.
37	1	28	—	23	2	39	—	27	—	25	—	25	1	387	8	St. Pancras.
55	2	66	1	55	—	62	1	70	—	75	—	68	2	740	16	Islington.
—	—	9	—	4	—	7	—	10	—	7	—	10	1	67	1	St. Mary, Stoke Newington.
28	1	53	1	39	—	34	1	37	—	21	—	29	3	440	11	Hackney.
3	—	6	—	3	—	2	—	7	—	3	—	3	—	58	3	St. Giles and St. George, Bloomsbury.
2	—	—	—	5	—	—	—	—	—	3	—	2	—	25	1	St. Martin-in-the-Fields.
3	1	4	—	5	—	2	—	7	—	3	—	3	—	45	1	Strand.†
2	—	6	—	2	—	11	—	4	—	3	—	—	—	50	—	Holborn.‡
9	—	8	—	18	—	20	—	23	—	9	—	19	—	179	1	Clerkenwell.
9	1	8	1	6	1	17	1	8	—	11	—	7	—	113	8	St. Luke, Middlesex.
3	—	5	—	3	—	10	—	6	—	3	1	4	—	92	2	London, City of.§
30	—	18	—	9	—	30	—	24	1	21	1	29	1	261	7	Shoreditch.
34	—	43	2	88	—	51	—	70	1	41	—	60	—	501	5	Bethnal Green.
25	4	21	2	42	—	36	—	31	—	25	—	38	—	335	7	Whitechapel.‖
4	—	9	—	10	2	8	1	12	—	10	—	9	—	113	5	St. George-in-the-East.
8	—	9	—	8	1	7	1	6	4	8	—	11	—	109	7	Limehouse.
29	—	22	—	28	—	16	—	38	—	27	—	37	1	321	6	Mile End Old Town.
23	2	18	1	21	2	21	—	23	—	23	2	21	1	285	12	Poplar.
4	—	5	—	—	—	6	—	1	—	2	—	5	—	43	—	St. Saviour, Southwark.
7	—	11	—	6	1	10	1	7	1	8	1	7	—	113	4	St. George, Southwark.
25	2	16	—	14	—	20	—	19	2	22	—	16	—	239	5	Newington.
—	—	1	—	2	—	—	—	2	—	—	—	—	—	15	1	St. Olave, Southwark.
15	—	16	—	10	—	9	—	13	—	9	1	12	—	140	4	Bermondsey.
5	—	8	—	5	1	3	—	2	—	6	—	2	1	51	3	Rotherhithe.
49	—	32	—	37	1	44	—	50	1	35	2	43	1	558	13	Lambeth.
20	—	37	—	38	2	34	—	32	—	28	—	27	1	339	4	Battersea.
20	—	14	2	15	—	26	1	12	1	17	1	13	1	238	7	Wandsworth.
33	4	38	—	31	1	32	1	32	—	34	—	30	—	372	10	Camberwell.
20	2	25	—	31	1	39	4	46	—	31	—	34	—	370	11	Greenwich.
9	—	8	1	4	—	7	—	2	—	2	—	1	—	77	1	Lewisham.
7	1	15	1	1	—	5	—	7	—	2	—	1	—	72	3	Woolwich.
6	—	4	—	6	—	10	—	9	—	9	—	8	—	109	1	Plumstead.
5	—	3	—	1	—	2	—	—	—	—	—	3	—	38	2	Lee.
—	—	—	—	1	—	—	—	—	—	—	—	—	—	1	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).
§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

District	Sanitary Areas.	Population (1891).	Oct. 3. Cases.	Oct. 3. Deaths.	Oct. 10. Cases.	Oct. 10. Deaths.	Oct. 17. Cases.	Oct. 17. Deaths.	Oct. 24. Cases.	Oct. 24. Deaths.	Oct. 31. Cases.	Oct. 31. Deaths.	Nov. 7. Cases.	Nov. 7. Deaths.	Nov. 14. Cases.	Nov. 14. Deaths.
	SCARLET FEVER—*continued.* Weekly Statement, 4th Quarter, 1896.															
	London - - - -	4,232,118	[a] 806	27	822	24	679	16	688	15	662	11	654	18	568	21
	(*Administrative County*) -	- -	[b] *771*	—	*788*	—	*649*	—	*644*	—	*633*	—	*626*	—	*544*	—
W. District.	Kensington - - -	166,308	25	1	33	—	29	—	25	2	22	—	36	—	14	3
	Fulham - - - -	91,639	23	2	31	—	16	—	18	—	16	—	30	1	19	1
	Hammersmith - -	97,239	14	—	11	—	11	1	3	—	16	—	14	—	8	1
	Paddington - - -	117,846	14	—	25	1	23	—	17	—	15	—	20	1	28	—
	Chelsea - - -	96,253	24	1	27	1	16	1	23	1	3	—	21	1	7	—
	St. George, Hanover Sq.* -	78,599	10	—	15	1	16	1	12	1	10	—	7	—	12	—
	Westminster - -	55,539	4	—	5	—	2	—	5	—	4	—	6	—	2	—
	St. James, Westminster -	24,995	2	—	—	—	5	—	—	—	4	—	—	—	1	—
N. District.	St. Marylebone - -	142,404	26	1	17	1	21	—	18	1	24	—	8	1	9	—
	Hampstead - - -	68,416	8	—	12	1	4	—	10	—	11	—	3	—	9	—
	St. Pancras - - -	234,379	42	1	38	—	22	—	19	—	34	—	28	—	27	2
	Islington - - -	319,143	75	1	69	3	66	1	58	1	50	2	40	—	57	2
	St. Mary, Stoke Newington	30,936	12	1	11	—	6	—	11	—	6	—	8	—	3	—
	Hackney - - -	198,606	40	1	47	1	40	3	59	—	72	—	52	—	42	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	10	—	15	—	5	—	2	—	1	—	8	—	13	1
	St. Martin-in-the-Fields -	14,616	3	—	1	—	1	—	1	—	—	—	3	—	6	—
	Strand† - - -	25,217	3	—	2	—	4	—	4	—	1	—	3	—	4	—
	Holborn‡ - - -	34,043	4	—	2	—	3	—	1	—	1	—	3	—	—	—
	Clerkenwell - - -	66,216	11	1	11	—	22	1	9	1	11	1	6	—	12	—
	St. Luke, Middlesex -	42,440	6	—	17	1	4	—	10	—	6	—	3	1	12	2
	London, City of§ - -	37,583	9	—	11	—	9	—	3	—	3	—	5	—	5	—
E. District.	Shoreditch - - -	124,009	27	3	17	2	12	—	17	—	19	1	12	—	18	—
	Bethnal Green - -	129,132	45	1	45	2	32	2	53	1	35	—	27	2	23	—
	Whitechapel‖ - -	74,420	20	—	24	1	9	—	18	—	11	3	10	1	13	—
	St. George-in-the-East -	45,795	8	—	15	2	18	—	7	1	5	—	10	—	4	—
	Limehouse - - -	57,376	9	—	15	—	5	—	10	—	13	—	7	1	7	—
	Mile End Old Town -	107,592	41	4	17	2	26	1	15	—	15	—	18	—	11	1
	Poplar - - -	166,748	24	1	28	—	20	—	30	—	16	—	22	—	18	—
S. District.	St. Saviour, Southwark -	27,177	1	—	4	—	2	1	4	—	6	—	4	—	9	1
	St. George, Southwark -	59,712	11	—	13	—	16	—	11	—	7	1	10	—	2	—
	Newington - - -	115,804	22	1	22	2	15	—	8	—	19	—	15	1	11	—
	St. Olave, Southwark -	12,723	1	—	1	—	—	—	3	—	—	—	1	—	—	—
	Bermondsey - - -	84,682	2	—	6	—	7	—	13	1	6	—	11	—	6	1
	Rotherhithe - - -	39,255	9	—	1	—	7	—	3	—	4	—	2	1	—	—
	Lambeth - - -	275,203	53	4	56	2	51	—	37	2	40	1	38	3	35	1
	Battersea - - -	150,558	41	—	24	1	31	—	30	1	37	—	47	1	29	—
	Wandsworth - -	156,942	26	—	37	—	34	—	46	1	37	1	35	2	28	—
	Camberwell - - -	235,344	35	1	41	—	29	1	33	1	28	1	20	1	15	—
	Greenwich - - -	165,413	53	—	31	—	28	2	32	—	32	—	44	—	37	4
	Lewisham - - -	92,647	4	—	9	—	6	—	5	—	17	—	6	—	4	—
	Woolwich - - -	40,848	2	—	3	—	1	—	1	—	1	—	6	—	—	1
	Plumstead - - -	52,436	5	2	8	—	4	1	3	—	4	—	4	—	8	—
	Lee - - - -	36,103	2	—	5	—	1	—	1	—	—	—	1	—	—	—
	Port of London - -	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

[a] Totals of actual *notifications*.
[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

SCARLET FEVER—*continued.*

Weekly Statement, 4th Quarter, 1896—*continued.* Nov. 21. Cases.	Nov. 21. Deaths.	Nov. 28. Cases.	Nov. 28. Deaths.	Dec. 5. Cases.	Dec. 5. Deaths.	Dec. 12. Cases.	Dec. 12. Deaths.	Dec. 19. Cases.	Dec. 19. Deaths.	Dec. 26. Cases.	Dec. 26. Deaths.	Jan. 2, 1897. Cases.	Jan. 2, 1897. Deaths.	Totals for 4th Quarter, 1896. Cases.	Totals for 4th Quarter, 1896. Deaths.	Grand Totals for Year 1896. Cases.	Grand Totals for Year 1896. Deaths.	Sanitary Areas.
551	19	540	19	503	26	528	16	443	19	296	12	451	19	8,191	262	27,035	940	London.
531	—	*516*	—	*484*	—	*504*	—	*425*	—	*281*	—	*451*	—	*7,845*	—	*25,679*	—	(*Administrative County.*)
22	—	29	1	17	2	24	1	17	—	18	1	15	1	326	12	1,077	40	Kensington.
14	2	19	2	7	—	18	2	11	—	9	—	14	—	245	10	649	29	Fulham.
20	—	10	—	21	2	10	—	5	—	8	—	18	1	169	5	555	21	Hammersmith.
17	—	9	1	15	—	15	—	8	1	14	—	17	2	237	6	853	22	Paddington.
22	—	15	—	16	—	10	1	8	1	14	—	3	—	209	7	595	23	Chelsea.
4	1	3	—	10	—	6	—	14	—	—	—	10	—	129	4	382	11	St. George, Hanover Sq.*
9	—	2	—	1	—	3	—	3	—	1	—	5	—	52	—	236	10	Westminster.
—	—	2	—	1	—	2	—	—	—	—	—	1	—	18	—	83	3	St. James, Westminster.
10	—	11	1	18	2	11	—	9	—	3	—	8	—	193	7	894	26	St. Marylebone.
9	2	8	—	11	—	9	—	8	—	5	—	5	—	112	3	310	7	Hampstead.
23	—	11	—	21	1	25	—	26	—	5	—	20	—	341	4	1,183	37	St. Pancras.
48	2	41	1	45	3	55	1	53	1	26	2	38	—	721	20	2,184	57	Islington.
4	—	4	1	4	—	5	—	2	—	4	—	1	—	81	2	240	8	St. Mary, Stoke Newington.
26	1	29	2	30	—	36	—	26	1	15	1	35	—	549	10	1,615	36	Hackney.
3	—	5	—	2	—	5	2	5	—	4	—	3	—	81	3	193	7	St. Giles and St. George, Bloomsbury.
1	—	1	—	1	—	6	—	1	—	—	—	3	1	28	1	73	3	St. Martin-in-the-Fields.
3	—	1	—	4	1	—	—	2	—	1	—	2	—	34	1	133	6	Strand.†
2	—	1	—	2	—	—	—	3	—	3	—	—	—	25	—	142	—	Holborn.‡
16	—	9	—	5	2	8	—	12	—	6	—	7	1	145	7	481	15	Clerkenwell.
12	—	8	—	10	1	5	—	3	—	2	—	4	3	102	8	278	21	St. Luke, Middlesex.
—	—	—	—	—	—	4	—	—	—	—	—	1	2	50	2	238	7	London, City of.§
22	—	20	—	19	1	18	1	9	1	6	—	16	—	232	9	728	39	Shoreditch.
16	—	29	1	12	—	10	—	24	—	19	—	20	—	390	9	1,344	35	Bethnal Green.
4	—	9	—	10	1	7	—	6	1	6	—	9	1	156	8	739	20	Whitechapel.‖
4	—	10	—	4	2	6	—	5	—	2	—	3	—	101	5	424	18	St. George-in-the-East.
10	1	9	—	5	—	9	—	6	—	4	—	7	—	116	2	373	15	Limehouse.
11	1	11	—	6	—	14	—	9	—	6	1	12	—	212	10	810	34	Mile End Old Town.
18	—	27	1	17	—	23	—	18	—	11	1	19	—	291	3	996	33	Poplar.
4	—	3	—	8	—	1	—	1	—	—	—	1	—	48	2	145	5	St. Saviour, Southwark.
3	—	9	—	13	—	4	—	6	—	3	1	9	—	117	2	344	17	St. George, Southwark.
14	1	17	—	15	1	15	—	7	3	5	2	19	1	204	12	693	29	Newington.
1	—	1	—	1	—	1	—	2	—	—	—	2	—	14	—	66	5	St. Olave, Southwark.
7	—	9	—	5	1	2	1	6	1	6	—	6	—	92	5	403	20	Bermondsey.
3	—	7	—	3	1	9	—	—	—	1	—	2	—	51	2	212	10	Rotherhithe.
36	1	26	1	31	1	32	1	31	2	23	1	23	1	512	21	1,661	65	Lambeth.
23	2	26	1	29	—	23	1	20	1	11	—	18	—	392	8	1,194	32	Battersea.
32	—	32	—	25	—	33	1	22	3	13	—	14	1	414	9	1,032	29	Wandsworth.
33	3	24	2	15	2	22	1	20	1	17	1	20	1	352	16	1,241	52	Camberwell.
26	1	27	2	20	1	19	2	17	1	14	1	19	2	399	16	1,190	51	Greenwich.
5	—	12	—	10	—	13	—	10	1	8	—	7	1	116	2	356	7	Lewisham.
2	—	1	—	3	—	1	—	1	—	—	—	3	—	25	1	147	9	Woolwich.
9	1	10	1	8	—	3	1	4	—	3	—	2	—	75	6	367	18	Plumstead.
3	—	3	1	3	1	3	—	3	—	—	—	10	—	35	2	171	8	Lee.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

District	Sanitary Areas.	Population (1891).	Jan. 4. Cases.	Jan. 4. Deaths.	Jan. 11. Cases.	Jan. 11. Deaths.	Jan. 18. Cases.	Jan. 18. Deaths.	Jan. 25. Cases.	Jan. 25. Deaths.	Feb. 1. Cases.	Feb. 1. Deaths.	Feb. 8. Cases.	Feb. 8. Deaths.
			Diphtheria. Weekly Statement, 1st Quarter, 1896.											
	London - - - -	4,232,118	[a]256	66	221	48	241	59	269	51	306	61	256	63
	(*Administrative County*) -	- -	[b]*245*	—	*214*	—	*229*	—	*265*	—	*288*	—	*240*	—
W. District.	Kensington - - -	166,308	12	2	4	1	6	—	10	2	2	2	5	1
W. District.	Fulham - - -	91,639	13	9	9	—	11	1	11	4	13	1	9	4
W. District.	Hammersmith - -	97,239	3	1	5	1	7	2	6	2	10	2	7	3
W. District.	Paddington - - -	117,846	7	1	5	3	2	3	2	—	9	1	5	1
W. District.	Chelsea - - -	96,253	6	3	10	2	7	2	9	2	14	5	8	5
W. District.	St. George, Hanover Sq.* -	78,599	1	—	1	—	3	1	3	—	10	—	3	1
W. District.	Westminster - -	55,539	1	2	5	1	—	—	4	—	3	1	7	—
W. District.	St. James, Westminster -	24,995	—	—	—	—	2	1	—	—	1	—	—	—
N. District.	St. Marylebone - -	142,404	5	1	7	4	11	1	3	—	8	3	9	2
N. District.	Hampstead - - -	68,416	3	—	4	2	12	—	11	2	5	2	10	2
N. District.	St. Pancras - - -	234,379	8	2	7	—	6	—	8	3	17	1	6	—
N. District.	Islington - - -	319,143	26	6	16	6	16	6	8	2	9	—	30	6
N. District.	St. Mary, Stoke Newington	30,936	1	2	1	—	2	—	1	—	1	1	1	—
N. District.	Hackney - - -	198,606	8	4	18	1	14	5	10	3	16	1	5	2
Central District.	St. Giles and St. George, Bloomsbury.	39,782	2	—	3	—	1	—	1	1	5	—	1	—
Central District.	St. Martin-in-the-Fields -	14,616	—	—	1	—	—	—	—	—	—	—	—	—
Central District.	Strand† - - -	25,217	2	—	—	—	—	—	1	1	1	—	—	—
Central District.	Holborn‡ - - -	34,043	—	—	2	1	1	1	2	—	—	—	1	—
Central District.	Clerkenwell - - -	66,216	2	1	5	—	1	3	7	—	—	—	2	1
Central District.	St. Luke, Middlesex -	42,440	2	—	3	3	1	1	3	—	3	—	5	—
Central District.	London, City of§ - -	37,583	6	—	3	1	4	—	—	—	2	—	2	—
E. District.	Shoreditch - - -	124,009	2	1	7	—	9	3	7	1	4	3	1	1
E. District.	Bethnal Green - -	129,132	18	6	4	1	3	2	5	2	6	3	8	3
E. District.	Whitechapel‖ - -	74,420	5	2	3	1	4	1	4	1	14	2	6	1
E. District.	St. George-in-the-East -	45,795	7	—	7	1	6	1	2	—	2	2	5	—
E. District.	Limehouse - -	57,376	4	—	4	1	8	—	2	1	4	1	4	—
E. District.	Mile End Old Town -	107,592	12	5	10	—	12	3	17	3	12	3	13	2
E. District.	Poplar - - -	166,748	15	—	6	2	6	2	9	1	14	1	13	1
S. District.	St. Saviour, Southwark -	27,177	1	—	1	—	—	1	2	—	1	1	—	—
S. District.	St. George, Southwark -	59,712	2	—	—	—	2	—	2	—	—	—	1	—
S. District.	Newington - - -	115,804	4	1	3	1	8	—	12	3	6	1	1	1
S. District.	St. Olave, Southwark -	12,723	1	—	—	—	—	—	—	—	1	—	1	—
S. District.	Bermondsey - - -	84,682	3	—	1	1	1	1	—	—	5	1	4	—
S. District.	Rotherhithe - - -	39,255	1	—	5	—	2	2	1	—	9	1	3	1
S. District.	Lambeth - - -	275,203	15	3	13	2	14	2	10	4	15	3	10	3
S. District.	Battersea - - -	150,558	12	4	12	4	15	2	8	2	9	—	8	5
S. District.	Wandsworth - -	156,942	11	—	1	1	2	—	4	—	5	—	5	1
S. District.	Camberwell - - -	235,344	17	4	10	—	16	2	30	4	23	6	25	2
S. District.	Greenwich - - -	165,413	7	2	12	4	14	4	33	4	27	8	16	6
S. District.	Lewisham - - -	92,647	1	—	3	—	3	—	4	—	6	2	7	2
S. District.	Woolwich - - -	40,848	—	—	—	—	2	1	7	1	1	—	3	2
S. District.	Plumstead - - -	52,436	10	4	7	2	5	4	6	2	9	3	3	3
S. District.	Lee - - -	36,103	—	—	3	1	2	1	4	—	4	—	3	1
S. District.	Port of London - -	—	—	—	—	—	—	—	—	—	—	—	—	—

[a] Totals of actual *notifications.*
[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population,235). † Including Middle Temple (population, 95).

Diphtheria—*continued.*																
Weekly Statement, 1st Quarter, 1896—*continued.*														Totals for 1st Quarter, 1896.		Sanitary Areas.
Feb. 15.		Feb. 22.		Feb. 29.		March 7.		March 14.		March 21.		March 28.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
237	44	256	48	245	48	217	46	264	44	283	52	234	51	3,285	681	London.
220	—	*236*	—	*227*	—	*203*	—	*247*	—	*266*	—	*229*	—	*3,106*	—	(*Administrative County.*)
13	5	3	1	7	—	4	—	8	3	11	3	2	—	87	20	Kensington.
2	1	5	3	10	3	9	3	13	4	14	1	11	1	130	35	Fulham.
5	—	5	2	2	1	1	—	5	1	14	2	8	1	78	18	Hammersmith.
4	4	2	—	2	—	3	2	5	3	6	—	3	1	55	19	Paddington.
3	1	7	2	10	2	1	—	2	1	3	—	7	—	87	25	Chelsea.
2	—	5	2	—	1	2	—	2	1	8	—	2	1	42	7	St. George, Hanover Sq.*
4	1	3	—	4	2	3	—	6	—	5	2	2	—	47	9	Westminster.
1	—	—	—	—	—	—	—	—	—	1	—	1	—	6	1	St. James, Westminster.
5	2	11	2	6	2	5	2	4	1	5	3	4	1	83	24	St. Marylebone.
11	2	5	—	4	1	4	—	8	—	6	1	7	2	90	14	Hampstead.
10	3	10	2	22	4	3	4	18	4	19	6	14	2	148	31	St. Pancras.
24	4	19	3	18	9	11	2	16	2	14	6	16	7	223	59	Islington.
3	1	3	1	1	—	3	1	2	—	1	—	1	1	21	7	St. Mary, Stoke Newington.
9	2	13	2	8	2	6	2	10	2	13	1	8	—	138	27	Hackney.
—	—	1	—	—	—	—	—	1	—	—	1	2	—	17	2	St. Giles and St. George Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	St. Martin-in-the-Fields.
1	—	3	—	—	—	—	—	1	—	—	—	1	—	10	1	Strand.†
3	—	1	—	—	—	—	—	2	1	—	—	3	—	15	3	Holborn.‡
3	—	5	—	7	2	8	3	5	—	5	1	1	—	51	11	Clerkenwell.
1	—	2	1	1	—	1	—	2	—	2	1	—	1	26	7	St. Luke, Middlesex.
—	—	—	—	1	—	—	1	1	—	—	—	2	—	21	2	London, City of.§
9	1	11	1	10	1	9	2	11	3	5	2	7	1	92	20	Shoreditch.
12	—	9	2	11	1	4	3	8	1	7	—	1	—	96	24	Bethnal Green.
6	3	3	—	11	2	3	—	9	—	10	1	7	2	85	16	Whitechapel.‖
2	—	6	—	4	—	5	—	—	—	5	1	2	3	53	8	St. George-in-the-East.
1	—	4	—	5	1	10	2	6	1	4	1	10	3	66	11	Limehouse.
14	—	12	2	9	2	12	2	13	2	14	1	13	1	163	26	Mile End Old Town.
9	1	9	2	12	2	6	2	12	—	12	—	18	2	141	16	Poplar.
1	—	—	—	—	—	—	—	2	—	2	1	—	—	10	3	St. Saviour, Southwark.
1	—	—	—	2	1	1	1	4	—	4	1	2	1	21	4	St. George, Southwark.
4	1	9	1	3	—	12	2	3	3	3	—	4	1	72	15	Newington.
—	—	—	—	—	—	—	1	—	—	—	—	1	—	4	1	St. Olave, Southwark.
—	—	2	—	3	—	4	—	—	—	4	—	—	1	27	4	Bermondsey.
—	—	1	—	—	—	4	—	4	1	—	1	1	—	31	6	Rotherhithe.
6	2	12	4	9	2	19	—	3	2	14	2	9	—	149	29	Lambeth.
5	1	18	1	17	1	9	2	9	1	7	2	11	2	140	27	Battersea.
7	1	2	2	1	—	4	—	9	—	6	1	4	2	61	8	Wandsworth.
21	1	19	6	18	1	32	8	29	5	40	6	20	5	300	50	Camberwell.
26	5	17	3	20	4	16	1	18	—	10	4	20	4	236	49	Greenwich.
4	1	11	1	3	1	1	—	3	—	5	—	5	3	56	10	Lewisham.
2	—	3	—	1	—	—	—	4	—	1	—	1	1	25	5	Woolwich.
1	1	3	—	1	—	2	—	5	1	3	—	2	1	57	21	Plumstead.
2	—	2	2	2	—	—	—	1	1	—	—	1	—	24	6	Lee.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

§ Including Inner Temple (population, 96).

‖ Including Tower of London (population, 868).

Sanitary Areas.		Population (1891).	DIPHTHERIA—*continued.* Weekly Statement, 2nd Quarter, 1896.											
			April 4.		April 11.		April 18.		April 25.		May 2.		May 9.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
London		4,232,118	[a]178	45	167	44	205	41	207	41	224	35	215	40
(*Administrative County*)		-	[b]*169*	—	*161*	—	*197*	—	*200*	—	*215*	—	*209*	—
W. District.	Kensington	166,308	—	—	2	1	10	2	10	1	6	1	7	1
	Fulham	91,639	6	2	7	—	5	—	2	1	3	1	8	—
	Hammersmith	97,239	1	4	2	2	5	—	2	1	4	1	4	3
	Paddington	117,846	5	2	4	—	1	—	2	1	4	1	3	1
	Chelsea	96,253	4	1	4	2	3	2	3	—	4	1	5	—
	St. George, Hanover Sq.*	78,599	1	2	3	1	1	1	4	—	3	—	—	—
	Westminster	55,539	1	—	3	—	1	—	3	1	3	1	1	—
	St. James, Westminster	24,995	—	—	1	—	—	—	2	—	2	—	—	—
N. District.	St. Marylebone	142,404	1	—	1	1	8	1	8	3	2	—	4	2
	Hampstead	68,416	3	2	—	—	4	—	1	—	—	—	5	—
	St. Pancras	234,379	10	5	2	5	9	—	7	—	7	1	8	1
	Islington	319,143	23	5	13	6	10	3	14	3	19	4	27	9
	St. Mary, Stoke Newington	30,936	1	—	2	1	—	—	—	—	3	—	1	—
	Hackney	198,606	5	2	7	—	13	3	8	1	10	2	10	1
Central District.	St. Giles and St. George, Bloomsbury.	39,782	2	—	1	—	1	—	2	1	1	1	4	—
	St. Martin-in-the-Fields	14,616	—	—	—	—	—	—	1	—	—	—	2	1
	Strand†	25,217	1	—	—	—	1	—	—	—	1	—	—	—
	Holborn‡	34,043	—	—	—	—	2	—	7	2	5	—	1	1
	Clerkenwell	66,216	5	1	5	1	4	1	3	1	1	—	2	—
	St. Luke, Middlesex	42,440	3	—	1	—	2	3	2	1	2	—	2	—
	London, City of §	37,583	—	—	—	—	—	—	—	—	5	1	5	—
E. District.	Shoreditch	124,009	5	—	4	—	2	—	3	2	4	—	7	2
	Bethnal Green	129,132	8	2	5	1	7	—	7	—	11	2	9	2
	Whitechapel‖	74,420	5	1	9	—	5	1	4	—	6	—	5	—
	St. George-in-the-East	45,795	3	—	6	1	3	1	9	2	3	—	3	—
	Limehouse	57,376	8	4	2	—	6	2	3	—	9	1	2	1
	Mile End Old Town	107,592	9	1	11	2	12	5	11	1	11	4	8	1
	Poplar	166,748	7	—	7	1	9	—	11	5	15	1	14	1
S. District.	St. Saviour, Southwark	27,177	2	—	—	—	3	—	—	—	1	—	—	1
	St. George, Southwark	59,712	3	2	2	1	2	—	1	—	3	—	2	1
	Newington	115,804	2	—	4	1	3	1	6	1	2	1	4	1
	St. Olave, Southwark	12,723	—	—	1	—	1	1	—	—	1	—	1	—
	Bermondsey	84,682	2	—	4	3	2	2	2	—	2	1	3	1
	Rotherhithe	39,255	1	—	—	—	—	—	—	—	—	—	—	—
	Lambeth	275,203	5	—	10	2	11	4	10	2	5	3	9	3
	Battersea	150,558	6	—	—	2	2	—	7	1	7	1	5	—
	Wandsworth	156,942	4	—	2	—	4	—	3	1	1	—	3	—
	Camberwell	235,344	10	3	14	2	21	4	20	2	32	2	17	2
	Greenwich	165,413	12	2	16	2	22	2	16	4	13	4	13	2
	Lewisham	92,647	6	2	5	1	3	1	4	—	4	—	6	—
	Woolwich	40,848	1	—	2	1	1	1	2	2	—	—	2	—
	Plumstead	52,436	6	2	3	3	5	—	4	1	5	—	2	2
	Lee	36,103	1	—	2	1	1	—	3	—	4	—	1	—
	Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—

[a] Totals of actual *notifications*.
[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

DIPHTHERIA—*continued.*

Weekly Statement, 2nd Quarter, 1896—*continued.* May 16. Cases.	May 16. Deaths.	May 23. Cases.	May 23. Deaths.	May 30. Cases.	May 30. Deaths.	June 6. Cases.	June 6. Deaths.	June 13. Cases.	June 13. Deaths.	June 20. Cases.	June 20. Deaths.	June 27. Cases.	June 27. Deaths.	Totals for 2nd Quarter, 1896. Cases.	Totals for 2nd Quarter, 1896. Deaths.	Sanitary Areas.
245	43	271	56	247	40	275	49	269	47	262	40	250	37	3,015	558	London.
232	—	*239*	—	*225*	—	*261*	—	*254*	—	*248*	—	*239*	—	*2,850*	—	(*Administrative County.*)
3	1	3	2	5	1	11	2	9	—	4	1	8	1	78	14	Kensington.
10	1	8	3	5	—	3	1	4	1	4	—	3	—	68	10	Fulham.
3	—	1	1	2	—	2	1	1	—	3	—	1	1	31	14	Hammersmith.
11	3	3	1	10	1	8	3	7	3	4	—	3	3	65	19	Paddington.
13	2	16	4	3	—	7	1	4	2	6	1	9	1	81	17	Chelsea.
2	—	8	—	1	1	6	2	—	—	1	—	1	—	31	7	St. George, Hanover Sq.*
1	—	1	—	—	—	—	—	2	—	1	—	1	—	18	2	Westminster.
—	—	1	—	1	—	—	—	3	1	1	—	2	—	13	1	St. James, Westminster.
5	2	7	—	3	3	9	—	7	—	2	—	5	2	62	14	St. Marylebone.
4	—	2	1	2	1	2	1	3	—	4	—	4	1	34	6	Hampstead.
10	3	15	1	12	1	8	—	9	1	14	2	8	—	119	20	St. Pancras.
20	6	29	6	33	9	21	5	24	1	35	5	33	6	301	68	Islington.
3	1	2	—	5	1	3	2	1	—	1	—	—	—	22	5	St. Mary, Stoke Newington.
4	2	11	2	2	1	7	1	15	1	11	—	15	5	118	21	Hackney.
1	—	3	—	2	—	2	—	—	1	2	—	1	—	22	3	St. Giles and St. George, Bloomsbury.
—	—	1	1	—	—	—	—	1	—	—	—	—	—	5	2	St. Martin-in-the-Fields.
—	—	—	1	1	—	2	—	1	—	—	—	2	1	9	2	Strand.†
—	—	5	—	2	—	3	—	1	—	—	—	—	—	26	3	Holborn.‡
6	—	4	1	8	—	4	2	2	—	3	—	8	1	55	8	Clerkenwell.
5	—	5	1	1	—	3	—	4	2	5	—	3	—	38	7	St. Luke, Middlesex.
—	—	—	—	1	—	1	—	2	—	1	1	1	—	16	2	London, City of.§
1	—	2	1	3	—	5	—	2	1	4	1	5	—	47	7	Shoreditch.
15	3	6	1	10	2	11	—	11	2	9	2	13	—	122	17	Bethnal Green.
5	—	11	2	6	—	5	1	5	—	3	—	3	—	72	5	Whitechapel.‖
2	—	4	—	8	1	4	1	6	2	4	—	1	—	56	8	St. George-in-the-East.
12	1	10	3	4	—	7	1	7	1	3	2	3	2	76	18	Limehouse.
12	2	8	2	12	1	16	—	10	2	18	1	4	—	142	22	Mile End Old Town.
14	3	7	—	15	3	14	2	15	2	16	6	15	1	159	25	Poplar.
—	—	4	—	—	1	1	1	3	—	1	—	1	—	16	3	St. Saviour, Southwark.
2	—	7	1	3	—	3	—	4	1	4	1	2	—	38	7	St. George, Southwark.
2	1	4	1	6	1	10	2	18	3	9	—	5	—	75	13	Newington.
—	—	—	—	—	—	1	—	1	—	1	—	1	—	8	1	St. Olave, Southwark.
2	1	3	1	4	1	5	1	4	—	6	3	7	1	46	15	Bermondsey.
—	—	1	—	3	—	1	—	4	1	—	—	4	—	14	1	Rotherhithe.
11	2	5	1	4	1	11	2	16	2	13	1	15	1	125	24	Lambeth.
7	4	10	2	5	1	6	2	8	1	6	1	4	—	73	15	Battersea.
6	—	6	2	1	—	9	—	4	1	3	—	3	1	49	5	Wandsworth.
23	2	21	7	27	6	30	8	28	5	24	6	33	7	300	56	Camberwell.
15	2	22	2	19	2	21	2	11	3	21	3	18	1	219	31	Greenwich.
7	1	9	2	10	—	3	1	4	3	9	2	1	1	71	14	Lewisham.
1	—	—	—	3	—	5	2	2	1	—	—	—	—	19	7	Woolwich.
3	—	4	2	4	1	4	1	4	3	6	1	4	—	54	16	Plumstead.
4	—	2	1	1	—	1	1	2	—	—	—	—	—	22	3	Lee.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).
§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

District	Sanitary Areas.	Population (1891).	DIPHTHERIA—*continued.* Weekly Statement, 3rd Quarter, 1896. July 4. Cases.	July 4. Deaths.	July 11. Cases.	July 11. Deaths.	July 18. Cases.	July 18. Deaths.	July 25. Cases.	July 25. Deaths.	Aug. 1. Cases.	Aug. 1. Deaths.	Aug. 8. Cases.	Aug. 8. Deaths.
	London	4,232,118	[a]279	43	282	47	286	53	312	50	294	43	278	54
	(*Administrative County*)	-	[b]*259*	—	*261*	—	*266*	—	*289*	—	*270*	—	*256*	—
W. District.	Kensington	166,208	8	2	6	1	13	4	7	1	18	2	7	2
W. District.	Fulham	91,639	4	2	6	—	4	—	6	1	8	—	7	2
W. District.	Hammersmith	97,239	3	—	1	—	2	—	4	2	3	—	4	1
W. District.	Paddington	117,846	4	—	6	2	8	1	4	—	3	—	6	1
W. District.	Chelsea	96,253	7	2	14	—	12	4	17	3	19	6	18	4
W. District.	St. George, Hanover Sq.*	78,599	1	—	1	—	7	—	1	—	3	—	1	—
W. District.	Westminster	55,539	1	—	—	—	3	—	3	1	1	—	3	1
W. District.	St. James, Westminster	24,995	1	—	—	—	—	—	1	—	1	—	3	—
N. District.	St. Marylebone	142,404	4	1	5	2	10	4	5	1	11	3	5	—
N. District.	Hampstead	68,416	11	1	3	2	3	2	3	—	4	—	6	—
N. District.	St. Pancras	234,379	5	1	10	—	12	1	10	2	9	—	8	1
N. District.	Islington	319,143	20	9	34	5	32	5	30	2	36	2	15	2
N. District.	St. Mary, Stoke Newington	30,936	1	—	—	—	1	—	2	—	1	—	1	—
N. District.	Hackney	198,606	13	4	12	—	8	4	14	1	9	1	9	3
Central District.	St. Giles and St. George, Bloomsbury.	39,782	1	—	1	—	3	—	2	—	—	—	1	—
Central District.	St. Martin-in-the-Fields	14,616	—	—	—	—	—	—	—	—	—	—	1	—
Central District.	Strand†	25,217	—	—	1	—	1	—	—	—	—	—	2	—
Central District.	Holborn‡	34,043	3	—	1	—	2	—	—	1	—	—	—	—
Central District.	Clerkenwell	66,216	7	—	2	—	7	1	9	1	5	2	4	—
Central District.	St. Luke, Middlesex	42,440	2	—	1	—	4	—	1	—	2	—	6	1
Central District.	London, City of§	37,583	7	—	3	—	1	1	2	1	—	1	1	—
E. District.	Shoreditch	124,009	4	1	14	3	10	3	13	—	5	4	7	3
E. District.	Bethnal Green	129,132	19	1	10	2	10	2	14	2	12	1	14	1
E. District.	Whitechapel‖	74,420	11	1	3	—	5	—	9	—	6	—	12	2
E. District.	St. George-in-the-East	45,795	8	—	4	2	9	—	7	1	5	—	3	—
E. District.	Limehouse	57,376	4	3	8	—	4	—	7	—	6	2	4	—
E. District.	Mile End Old Town	107,592	7	2	10	1	12	1	19	1	7	—	8	2
E. District.	Poplar	166,748	14	1	29	3	17	2	15	4	14	1	14	3
S. District.	St. Saviour, Southwark	27,177	2	—	1	2	2	—	4	1	4	1	3	—
S. District.	St. George, Southwark	59,712	2	—	1	2	7	3	9	2	1	1	6	1
S. District.	Newington	115,804	9	—	10	2	11	1	11	2	12	1	13	2
S. District.	St. Olave, Southwark	12,723	2	—	—	—	1	—	1	—	1	—	—	—
S. District.	Bermondsey	84,682	5	—	5	3	10	2	7	3	6	2	5	1
S. District.	Rotherhithe	39,255	2	—	3	1	—	—	1	—	—	—	2	1
S. District.	Lambeth	275,203	20	—	10	4	13	2	18	5	12	—	13	1
S. District.	Battersea	150,558	12	4	9	1	3	1	3	—	7	1	6	4
S. District.	Wandsworth	156,942	6	1	8	2	3	—	2	2	1	—	6	1
S. District.	Camberwell	235,344	24	4	28	2	18	5	22	7	37	4	30	9
S. District.	Greenwich	165,413	17	1	11	3	11	2	17	1	10	4	14	1
S. District.	Lewisham	92,647	—	—	4	1	2	1	1	—	9	2	1	2
S. District.	Woolwich	40,848	2	—	3	1	3	—	2	—	—	1	3	—
S. District.	Plumstead	52,436	5	2	2	—	2	—	9	2	6	1	6	2
S. District.	Lee	36,103	1	—	2	—	—	1	—	—	—	—	—	—
S. District.	Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—

[a] Totals of actual *notifications*.
[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

DIPHTHERIA—*continued.*

Weekly Statement, 3rd Quarter, 1896—*continued.*														Totals for 3rd Quarter, 1896.		Sanitary Areas.
Aug. 15.		Aug. 22.		Aug. 29.		Sept. 5.		Sept. 12.		Sept. 19.		Sept. 26.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
302	59	249	59	234	32	302	48	320	48	291	49	336	60	3,765	645	London.
272	—	*232*	—	*222*	—	*280*	—	*304*	—	*277*	—	*311*	—	*3,499*	—	(*Administrative County.*)
10	1	12	1	4	1	8	—	6	—	4	2	7	3	110	20	Kensington.
13	2	3	3	8	1	7	1	6	3	3	—	7	2	82	17	Fulham.
—	—	3	2	3	—	2	1	5	1	6	—	6	1	42	8	Hammersmith.
2	1	5	1	6	1	2	2	2	—	1	—	3	2	52	11	Paddington.
21	3	7	4	11	2	23	5	21	1	22	4	22	2	214	40	Chelsea.
3	—	2	—	1	—	2	—	4	1	—	—	5	—	31	1	St. George, Hanover Sq.*
1	—	—	—	—	—	—	—	2	—	1	—	7	1	22	3	Westminster.
—	—	—	—	1	—	—	—	1	—	—	—	1	—	9	—	St. James, Westminster.
13	2	9	1	7	—	5	1	6	1	3	1	3	—	86	17	St. Marylebone.
6	—	1	1	—	1	4	—	1	—	2	—	—	—	44	7	Hampstead.
11	3	5	6	4	2	4	—	8	1	13	—	15	4	114	21	St. Pancras.
27	7	19	5	15	1	21	6	22	7	28	5	28	4	327	60	Islington.
2	—	—	—	3	1	—	—	1	—	—	—	6	1	18	2	St. Mary, Stoke Newington.
11	1	5	1	11	3	6	—	6	—	13	—	10	3	127	21	Hackney.
—	—	1	1	1	—	1	—	1	1	2	—	—	—	14	2	St. Giles and St. George, Bloomsbury.
2	—	1	—	—	—	—	—	1	—	—	—	—	—	5	—	St. Martin-in-the-Fields.
—	—	2	—	—	—	—	—	—	—	1	—	1	—	8	—	Strand.†
1	—	4	2	—	—	—	—	4	—	1	1	—	—	16	4	Holborn.‡
3	1	4	—	3	—	6	1	4	1	4	—	12	—	70	7	Clerkenwell.
2	2	—	1	2	—	2	—	1	—	4	—	2	—	29	4	St. Luke, Middlesex.
—	—	1	2	1	—	2	—	3	—	—	1	1	—	22	6	London, City of.§
5	—	9	—	6	2	13	1	4	2	6	—	8	1	104	20	Shoreditch.
6	2	13	1	15	—	9	1	2	—	9	1	10	1	143	15	Bethnal Green.
9	1	6	1	10	—	16	2	10	3	15	2	17	1	129	13	Whitechapel.‖
1	—	8	—	2	2	3	—	3	—	1	—	4	1	58	6	St. George-in-the-East.
8	1	8	—	2	—	5	1	4	—	5	—	5	1	70	8	Limehouse.
11	4	7	2	8	—	12	2	29	4	26	2	12	7	168	28	Mile End Old Town.
13	2	13	1	12	—	16	4	16	2	6	3	11	1	190	27	Poplar.
1	1	4	1	—	—	1	—	3	1	1	—	2	1	28	8	St. Saviour, Southwark.
3	2	5	1	10	1	14	—	6	—	5	2	4	2	73	17	St. George, Southwark.
19	4	10	2	13	3	18	3	4	—	4	—	8	1	142	21	Newington.
1	—	—	—	—	—	—	—	1	—	2	1	—	—	9	1	St. Olave, Southwark.
3	2	8	1	7	1	9	1	15	3	10	7	3	2	93	28	Bermondsey.
12	1	1	2	3	—	4	—	—	—	6	2	3	1	37	8	Rotherhithe.
9	4	15	4	15	2	8	2	34	5	17	1	20	3	204	33	Lambeth.
5	1	6	—	9	—	7	1	9	3	12	1	6	—	94	17	Battersea.
12	2	5	2	5	1	2	1	5	—	4	—	6	1	65	13	Wandsworth.
32	4	28	4	20	4	32	6	37	6	28	8	30	6	366	69	Camberwell.
17	3	14	4	11	2	29	3	19	1	13	4	27	6	210	35	Greenwich.
2	—	2	—	3	—	1	2	10	—	7	—	17	—	59	8	Lewisham.
—	1	1	2	1	1	2	—	—	—	1	—	—	—	18	6	Woolwich.
5	1	2	—	1	—	6	1	4	1	5	1	5	1	58	12	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	2	—	5	1	Lee.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

§ Including Inner Temple (population, 96).

‖ Including Tower of London (population, 868).

Sanitary Areas.		Population (1891).	Oct. 3. Cases.	Oct. 3. Deaths.	Oct. 10. Cases.	Oct. 10. Deaths.	Oct. 17. Cases.	Oct. 17. Deaths.	Oct. 24. Cases.	Oct. 24. Deaths.	Oct. 31. Cases.	Oct. 31. Deaths.	Nov. 7. Cases.	Nov. 7. Deaths.	Nov. 14. Cases.	Nov. 14. Deaths.
			DIPHTHERIA—*continued.* Weekly Statement, 4th Quarter, 1896.													
London - - - -		4,232,118	[a]341	69	345	52	322	66	280	56	284	64	288	52	285	59
(*Administrative County*) -		- -	[b]*318*	—	*322*	—	*294*	—	*262*	—	*261*	—	*275*	—	*262*	—
W. District.	Kensington - - -	166,208	9	1	5	1	9	1	—	—	2	1	10	—	10	3
	Fulham - - -	91,639	7	1	7	2	4	1	4	1	2	—	10	2	2	—
	Hammersmith - -	97,239	7	1	6	—	2	1	2	—	9	1	13	3	8	—
	Paddington - - -	117,846	—	—	3	—	7	3	6	2	5	1	4	—	3	—
	Chelsea - - -	96,253	10	4	8	3	6	3	14	1	17	5	9	3	19	4
	St. George, Hanover Sq.* -	78,599	—	—	8	—	5	2	6	1	1	1	2	—	—	—
	Westminster - -	55,539	1	4	5	—	1	—	1	1	3	—	3	—	2	—
	St. James, Westminster -	24,995	—	—	—	—	—	—	—	—	—	—	—	—	1	—
N. District.	St. Marylebone - -	142,404	8	2	8	—	8	2	6	1	3	1	2	1	6	3
	Hampstead - - -	68,416	2	—	2	—	3	—	1	—	1	—	1	—	—	1
	St. Pancras - - -	234,379	19	2	9	2	14	2	10	5	13	1	7	2	14	1
	Islington - - -	319,143	25	5	28	1	25	6	20	8	12	6	21	5	22	7
	St. Mary, Stoke Newington	30,936	1	—	1	1	—	—	3	—	1	—	1	—	—	—
	Hackney - - -	198,606	17	3	10	—	13	4	19	3	18	4	25	5	10	3
Central District.	St. Giles and St. George, Bloomsbury.	39,782	2	—	2	—	—	—	—	—	—	—	1	—	—	—
	St. Martin-in-the-Fields -	14,616	—	—	1	1	—	—	—	—	—	—	2	—	—	—
	Strand† - - -	25,217	1	—	—	—	—	—	—	—	1	—	—	—	2	—
	Holborn‡ - - -	34,043	7	1	6	1	1	—	—	—	1	—	—	—	—	—
	Clerkenwell - - -	66,216	7	5	3	2	10	—	2	1	6	—	2	—	10	2
	St. Luke, Middlesex -	42,440	4	—	5	1	—	—	—	—	2	—	3	—	4	—
	London, City of§ - -	37,583	—	—	1	—	2	—	—	—	—	—	2	—	1	—
E. District.	Shoreditch - - -	124,009	4	3	8	3	9	—	17	2	10	4	16	—	12	2
	Bethnal Green - -	129,132	15	2	9	2	8	—	9	2	7	1	8	—	6	2
	Whitechapel‖ - -	74,420	10	1	6	2	10	—	7	1	3	—	2	—	7	—
	St. George-in-the-East -	45,795	5	—	5	2	12	1	3	—	7	—	4	1	3	—
	Limehouse - - -	57,376	5	2	5	—	5	—	5	1	5	—	5	3	8	1
	Mile End Old Town -	107,592	10	2	7	—	9	1	9	2	7	1	6	2	8	—
	Poplar - - -	166,748	9	2	22	3	11	3	19	1	9	5	9	1	16	6
S. District.	St. Saviour, Southwark -	27,177	3	—	1	—	—	—	—	—	1	1	8	—	5	2
	St. George, Southwark -	59,712	4	—	6	—	10	—	6	2	2	2	3	2	1	—
	Newington - - -	115,804	8	—	9	2	6	4	8	1	4	2	9	—	5	1
	St. Olave, Southwark -	12,723	1	—	6	—	1	1	1	—	—	—	1	—	—	1
	Bermondsey - - -	84,682	9	1	6	2	5	3	7	1	5	—	4	2	5	1
	Rotherhithe - - -	39,255	9	2	2	1	2	—	1	—	2	2	3	1	4	2
	Lambeth - - -	275,203	17	3	25	4	19	3	14	4	18	4	21	5	13	4
	Battersea - - -	150,558	6	1	5	1	7	2	1	1	11	2	7	1	9	1
	Wandsworth - -	156,942	4	—	7	—	11	1	19	1	21	3	4	—	4	3
	Camberwell - - -	235,344	41	9	40	5	44	10	37	8	35	10	33	6	35	4
	Greenwich - - -	165,413	23	4	20	4	14	2	7	1	16	2	13	—	12	2
	Lewisham - - -	92,647	23	6	26	6	23	9	10	2	22	3	11	5	8	2
	Woolwich - - -	40,848	—	—	2	—	4	—	2	1	1	1	—	—	4	—
	Plumstead - - -	52,436	8	1	3	—	1	—	2	—	—	—	3	2	—	—
	Lee - - - -	36,103	—	1	7	—	1	1	2	1	1	—	—	—	6	1
	Port of London - -	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

[a] Totals of actual *notifications.*
[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

DIPHTHERIA—*continued*.

Weekly Statement, 4th Quarter, 1896—*continued*. Nov. 21. Cases.	Nov. 21. Deaths.	Nov. 28. Cases.	Nov. 28. Deaths.	Dec. 5. Cases.	Dec. 5. Deaths.	Dec. 12. Cases.	Dec. 12. Deaths.	Dec. 19. Cases.	Dec. 19. Deaths.	Dec. 26. Cases.	Dec. 26. Deaths.	Jan. 2, 1897. Cases.	Jan. 2, 1897. Deaths.	Totals for 4th Quarter, 1896. Cases.	Totals for 4th Quarter, 1896. Deaths.	Grand Totals for Year 1896. Cases.	Grand Totals for Year 1896. Deaths.	Sanitary Areas.
302	58	287	48	279	59	303	52	298	58	220	37	318	49	4,152	779	14,217	2,663	London.
289	—	*273*	—	*267*	—	*293*	—	*284*	—	*200*	—	*318*	—	*3,918*	—	*13,373*	—	(*Administrative County.*)
4	3	5	—	6	1	11	2	10	—	8	2	13	1	102	16	377	70	Kensington.
6	—	5	—	7	1	6	2	5	3	4	1	9	1	78	15	358	77	Fulham.
4	1	2	1	4	1	6	1	5	1	4	—	3	1	75	12	226	52	Hammersmith.
4	—	5	—	6	2	11	3	15	2	7	2	5	1	81	16	253	65	Paddington.
10	—	8	3	10	1	13	1	16	3	4	1	7	1	151	33	533	115	Chelsea.
3	—	3	—	—	1	3	1	2	—	4	1	5	2	42	9	146	24	St. George, Hanover Sq.*
3	—	1	—	2	—	2	—	3	—	3	1	1	—	31	6	118	20	Westminster.
1	—	1	—	—	—	1	—	1	—	—	—	3	—	8	—	36	2	St. James, Westminster.
6	1	4	3	5	—	9	1	2	—	7	3	7	1	81	19	312	74	St. Marylebone.
3	—	8	—	1	—	3	1	13	1	—	—	2	—	40	3	208	30	Hampstead.
11	5	7	1	9	1	9	1	6	1	1	—	16	3	145	27	526	99	St. Pancras.
27	4	19	2	21	5	18	5	18	6	21	3	31	5	308	68	1,159	255	Islington.
1	—	2	—	1	2	3	—	1	—	5	—	2	2	22	5	83	19	St. Mary, Stoke Newington.
25	1	22	1	10	5	22	1	6	2	5	2	11	—	213	34	596	103	Hackney.
—	—	—	—	1	—	1	—	—	—	1	—	—	—	8	—	61	7	St. Giles and St. George, Bloomsbury.
—	—	—	—	1	—	—	—	—	—	—	—	—	—	4	1	15	3	St. Martin-in-the-Fields.
—	—	—	—	1	—	2	—	—	—	1	—	—	—	8	—	35	3	Strand.†
—	—	2	—	1	—	1	—	—	—	4	—	2	—	25	2	82	12	Holborn.‡
6	1	9	—	5	1	6	1	7	1	7	1	3	1	83	16	259	42	Clerkenwell.
6	2	3	—	3	2	3	2	3	—	3	—	7	1	46	8	139	26	St. Luke, Middlesex.
—	—	3	1	—	—	1	—	—	—	—	—	4	—	14	1	73	11	London, City of.§
11	4	8	2	8	2	8	1	5	4	2	—	9	—	127	27	370	74	Shoreditch.
5	2	2	3	10	—	5	1	7	2	5	—	9	2	105	19	466	75	Bethnal Green.
10	1	9	2	14	2	5	1	10	2	5	1	7	1	105	14	391	48	Whitechapel.‖
4	1	6	2	6	1	6	—	6	—	1	—	3	—	71	8	238	30	St. George-in-the-East.
7	1	7	—	6	3	4	1	4	—	2	—	4	—	72	12	284	49	Limehouse.
8	2	4	2	9	2	14	2	8	3	6	—	15	2	120	21	593	97	Mile End Old Town.
17	2	15	3	18	3	15	2	18	3	8	—	20	3	206	37	696	105	Poplar.
1	1	3	—	1	—	—	—	1	—	4	—	3	—	31	4	85	18	St. Saviour, Southwark.
2	—	1	—	5	2	6	1	3	—	3	2	3	1	55	12	187	40	St. George, Southwark.
9	3	12	3	8	—	4	1	12	1	6	2	11	2	111	22	400	71	Newington.
1	1	3	—	—	—	—	1	—	—	6	1	4	1	24	6	45	9	St. Olave, Southwark.
7	1	14	3	5	3	11	4	8	1	9	3	4	1	99	26	265	73	Bermondsey.
2	1	2	—	2	—	7	1	3	—	1	—	5	1	45	11	127	26	Rotherhithe.
16	5	10	2	22	3	20	1	12	6	10	4	16	5	233	53	711	139	Lambeth.
6	4	16	2	5	2	11	2	11	3	7	1	5	—	107	23	414	82	Battersea.
10	—	11	1	14	2	4	—	7	1	1	—	14	2	131	14	306	40	Wandsworth.
29	6	31	3	20	4	28	3	41	10	37	2	30	5	481	85	1,447	260	Camberwell.
12	—	9	2	13	3	9	3	15	—	2	2	9	—	174	25	839	140	Greenwich.
15	2	7	2	13	1	7	1	5	1	8	2	10	1	188	43	374	75	Lewisham.
4	2	3	3	5	1	3	3	8	—	1	—	2	2	39	13	101	31	Woolwich.
2	—	2	—	—	1	5	1	1	1	1	—	3	—	31	6	200	55	Plumstead.
4	1	3	1	1	1	—	—	—	—	—	—	1	—	26	7	77	17	Lee.
—	—	—	—	—	—	—	—	—	—	6	—	—	—	6	—	6	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).
§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

District	Sanitary Areas.	Population (1891).	Enteric Fever. Weekly Statement, 1st Quarter, 1896. Jan. 4. Cases.	Jan. 4. Deaths.	Jan. 11. Cases.	Jan. 11. Deaths.	Jan. 18. Cases.	Jan. 18. Deaths.	Jan. 25. Cases.	Jan. 25. Deaths.	Feb. 1. Cases.	Feb. 1. Deaths.	Feb. 8. Cases.	Feb. 8. Deaths.
	London - - - -	4,232,118	[a] 89	13	88	13	46	12	56	16	89	11	52	7
	(*Administrative County*) -	- -	[b] *84*	—	*78*	—	*42*	—	*50*	—	*83*	—	*51*	—
W. District.	Kensington - - -	166,308	2	—	6	—	—	1	1	1	1	—	—	—
W. District.	Fulham - - -	91,639	—	—	1	—	1	—	—	—	—	—	2	—
W. District.	Hammersmith -	97,239	—	—	1	1	—	—	1	2	2	—	—	—
W. District.	Paddington - - -	117,846	4	—	3	1	—	—	1	2	—	—	1	—
W. District.	Chelsea - - -	96,253	2	—	1	1	2	—	—	—	—	—	—	—
W. District.	St. George, Hanover Sq.* -	78,599	—	—	2	—	1	1	1	—	4	—	1	—
W. District.	Westminster - -	55,539	—	—	—	—	—	—	2	—	—	1	—	—
W. District.	St. James, Westminster -	24,995	1	—	—	—	—	1	—	—	1	—	—	—
N. District.	St. Marylebone - -	142,404	5	—	3	—	2	2	1	1	7	—	—	—
N. District.	Hampstead - - -	68,416	1	1	1	—	2	—	—	—	1	1	—	—
N. District.	St. Pancras - - -	234,379	4	—	7	—	3	—	2	—	8	—	3	—
N. District.	Islington - - -	319,143	6	2	5	1	4	1	4	2	1	1	3	1
N. District.	St. Mary, Stoke Newington	30,936	—	—	1	1	1	—	1	—	1	—	—	1
N. District.	Hackney - - -	198,606	11	—	9	1	7	—	7	1	5	1	1	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	—	—	—	—	1	—	1	—
Central District.	St. Martin-in-the-Fields -	14,616	—	—	2	—	1	—	1	—	1	—	—	—
Central District.	Strand† - - -	25,217	1	—	1	—	—	—	—	—	—	—	1	—
Central District.	Holborn‡ - - -	34,043	—	—	—	—	—	—	—	—	—	—	1	—
Central District.	Clerkenwell - - -	66,216	4	—	3	—	—	—	—	—	6	1	2	—
Central District.	St. Luke, Middlesex -	42,440	2	—	3	—	2	—	—	—	—	—	1	—
Central District.	London, City of§ - -	37,583	2	—	—	1	1	2	—	—	1	1	—	—
E. District.	Shoreditch - - -	124,009	3	—	—	—	2	—	2	1	3	—	1	1
E. District.	Bethnal Green - -	129,132	—	—	6	3	2	—	3	1	3	—	5	—
E. District.	Whitechapel‖ - -	74,420	5	—	—	1	1	—	1	—	1	1	—	—
E. District.	St. George-in-the-East -	45,795	1	—	—	—	—	1	2	—	4	—	—	—
E. District.	Limehouse - - -	57,376	1	—	—	—	1	—	—	—	1	—	1	—
E. District.	Mile End Old Town -	107,592	2	1	3	—	2	—	3	1	3	—	2	—
E. District.	Poplar - - -	166,748	5	1	4	—	3	—	3	1	7	2	4	—
S. District.	St. Saviour, Southwark -	27,177	—	—	—	—	—	—	—	—	1	—	—	—
S. District.	St. George, Southwark -	59,712	1	—	—	—	—	—	—	—	2	—	—	1
S. District.	Newington - - -	115,804	1	—	—	—	—	—	1	—	1	—	—	—
S. District.	St. Olave, Southwark -	12,723	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Bermondsey - -	84,682	—	1	2	—	—	—	—	—	1	—	1	—
S. District.	Rotherhithe - -	39,255	7	1	6	—	1	—	3	1	2	—	4	1
S. District.	Lambeth - - -	275,203	6	1	4	1	1	2	5	—	2	—	3	—
S. District.	Battersea - - -	150,558	4	—	4	—	1	—	5	—	5	—	1	—
S. District.	Wandsworth - -	156,942	4	1	2	1	2	1	2	—	6	2	1	—
S. District.	Camberwell - -	235,344	3	3	3	—	—	—	3	1	4	—	4	1
S. District.	Greenwich - - -	165,413	—	—	1	—	—	—	—	—	2	—	5	1
S. District.	Lewisham - - -	92,647	—	—	4	—	—	—	—	—	1	—	2	—
S. District.	Woolwich - - -	40,848	—	—	—	—	—	—	1	—	—	—	—	—
S. District.	Plumstead - - -	52,436	—	—	—	—	—	—	—	—	—	—	1	—
S. District.	Lee - - - -	36,103	1	1	—	—	3	—	—	1	—	—	—	—
S. District.	Port of London - -	—	—	—	—	—	—	—	—	—	—	—	—	—

[a] Totals of actual *notifications.*
[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

Enteric Fever—*continued.*																
Weekly Statement, 1st Quarter, 1896—*continued.*														Totals for 1st Quarter, 1896.		Sanitary Areas.
Feb. 15.		Feb. 22.		Feb. 29.		March 7.		March 14.		March 21.		March 28.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
59	10	50	16	33	8	36	7	40	9	38	5	41	6	717	133	London.
54	—	*47*	—	*31*	—	*35*	—	*37*	—	*38*	—	*38*	—	*668*	—	(*Administrative County.*)
1	—	—	—	—	—	1	—	2	—	—	—	—	—	14	2	Kensington.
1	—	—	—	—	—	2	—	1	—	1	—	1	1	10	1	Fulham.
1	—	—	1	—	—	1	—	—	—	—	—	3	—	9	4	Hammersmith.
—	—	3	1	2	1	—	—	1	—	1	—	—	—	16	5	Paddington.
3	—	2	—	—	—	—	—	—	1	5	1	3	—	18	3	Chelsea.
3	1	—	—	2	1	—	—	2	1	—	—	—	—	16	4	St. George, Hanover Sq.*
1	—	—	—	1	—	1	—	—	—	1	—	2	—	8	1	Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	1	St. James, Westminster.
1	—	1	1	—	—	—	—	1	—	1	—	—	—	22	4	St. Marylebone.
3	—	1	—	—	—	2	—	1	—	—	—	1	—	13	2	Hampstead.
3	—	4	—	2	1	4	—	2	—	2	—	—	—	44	1	St. Pancras.
2	—	3	2	1	—	—	1	6	1	4	1	1	—	40	13	Islington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	2	St. Mary, Stoke Newington.
2	—	—	—	1	—	—	—	4	—	1	—	4	—	52	3	Hackney.
—	—	2	—	1	—	1	1	—	—	—	—	—	—	6	1	St. Giles and St. George, Bloomsbury.
—	—	—	1	—	—	—	—	1	—	—	—	—	—	6	1	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	Strand.†
1	—	—	—	—	—	—	—	—	—	1	—	—	—	3	—	Holborn.‡
1	1	1	1	1	—	1	—	1	—	1	—	1	—	22	3	Clerkenwell.
1	—	—	—	—	—	1	—	1	—	1	—	1	—	13	—	St. Luke, Middlesex.
—	—	2	—	1	—	—	—	—	—	—	1	—	—	7	5	London, City of.§
3	—	1	—	1	—	3	—	1	—	—	1	1	—	21	3	Shoreditch.
5	—	2	—	3	—	—	1	3	1	1	—	—	—	33	6	Bethnal Green.
—	—	2	1	—	—	—	—	—	—	2	—	—	—	12	3	Whitechapel.‖
—	—	—	1	1	—	—	—	—	—	—	—	—	—	8	2	St. George-in-the-East.
1	—	1	—	—	—	1	—	—	—	1	—	—	—	8	—	Limehouse.
3	1	3	—	1	—	1	1	4	—	2	—	2	1	31	5	Mile End Old Town.
4	—	2	—	1	1	1	2	3	—	1	—	7	1	45	8	Poplar.
—	—	1	—	—	—	—	—	—	—	—	—	1	—	3	—	St. Saviour, Southwark.
—	—	1	—	—	—	—	—	—	—	—	—	3	1	7	2	St. George, Southwark.
1	1	—	—	2	1	—	—	—	1	1	—	—	—	7	3	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	St. Olave, Southwark.
1	—	1	2	2	2	—	—	—	—	—	—	3	—	11	5	Bermondsey.
1	—	—	—	2	—	2	—	1	1	1	—	—	—	30	4	Rotherhithe.
1	—	3	—	—	—	1	—	—	1	—	—	—	—	26	5	Lambeth.
2	—	2	1	1	—	3	—	—	—	1	—	—	—	29	1	Battersea.
3	1	1	—	1	—	3	—	1	—	2	—	1	1	29	7	Wandsworth.
6	4	5	1	4	—	4	1	2	2	2	—	1	—	41	13	Camberwell.
1	1	5	3	1	1	2	—	2	—	3	—	3	1	25	7	Greenwich.
1	—	—	—	—	—	1	—	—	—	—	—	1	—	10	—	Lewisham.
2	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	Woolwich.
—	—	—	—	1	—	—	—	—	—	1	1	—	—	3	1	Plumstead.
—	—	1	—	—	—	—	—	—	—	1	—	—	—	6	2	Lee.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

District	Sanitary Areas.	Population (1891).	ENTERIC FEVER—*continued.* Weekly Statement, 2nd Quarter, 1896. April 4. Cases.	April 4. Deaths.	April 11. Cases.	April 11. Deaths.	April 18. Cases.	April 18. Deaths.	April 25. Cases.	April 25. Deaths.	May 2. Cases.	May 2. Deaths.	May 9. Cases.	May 9. Deaths.
	London - - - -	4,232,118	[a]35	6	30	4	37	5	52	6	54	10	41	4
	(*Administrative County*) -	- -	[b]*34*	—	*30*	—	*35*	—	*51*	—	*53*	—	*39*	—
W. District.	Kensington - - -	166,308	—	—	—	—	1	—	—	—	3	—	2	—
W. District.	Fulham - - -	91,639	—	—	1	—	—	1	1	—	—	1	—	—
W. District.	Hammersmith - -	97,239	—	—	2	—	—	—	1	1	1	1	1	—
W. District.	Paddington - - -	117,846	1	1	2	—	2	—	1	1	2	—	3	—
W. District.	Chelsea - - -	96,253	—	—	1	—	1	—	1	—	—	—	—	—
W. District.	St. George, Hanover Sq.* -	78,599	1	—	—	—	1	—	—	—	1	1	—	—
W. District.	Westminster - -	55,539	—	—	—	—	—	—	2	—	—	—	1	1
W. District.	St. James, Westminster -	24,995	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Marylebone - -	142,404	2	—	—	—	3	—	1	1	1	—	2	—
N. District.	Hampstead - - -	68,416	—	—	2	1	—	—	2	—	1	—	1	—
N. District.	St. Pancras - - -	234,379	—	1	2	—	4	1	2	1	—	—	—	—
N. District.	Islington - - -	319,143	3	—	1	—	1	—	4	—	1	2	5	—
N. District.	St. Mary, Stoke Newington	30,936	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	Hackney - - -	198,606	1	—	1	—	1	1	5	—	3	1	1	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	—	—	—	—	2	—	—	—
Central District.	St. Martin-in-the-Fields -	14,616	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	Strand† - - -	25,217	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	Holborn‡ - - -	34,043	1	—	—	—	—	—	1	—	1	1	—	—
Central District.	Clerkenwell - - -	66,216	1	—	—	—	1	—	—	—	—	—	4	—
Central District.	St. Luke, Middlesex -	42,440	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	London, City of § - -	37,583	—	—	—	—	—	—	—	—	1	1	—	—
E. District.	Shoreditch - - -	124,009	3	—	1	1	1	—	4	—	4	1	3	1
E. District.	Bethnal Green - -	129,132	1	—	—	—	2	—	1	—	4	—	1	1
E. District.	Whitechapel‖ - -	74,420	1	—	1	—	2	—	—	—	2	—	—	—
E. District.	St. George-in-the-East -	45,795	—	—	—	—	1	—	1	—	—	—	1	—
E. District.	Limehouse - - -	57,376	1	—	—	—	1	—	—	—	—	—	—	—
E. District.	Mile End Old Town -	107,592	3	—	1	—	1	—	5	—	2	—	2	—
E. District.	Poplar - - -	166,748	1	—	2	—	2	—	—	—	3	—	2	—
S. District.	St. Saviour, Southwark -	27,177	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	St. George, Southwark -	59,712	2	—	—	—	—	—	—	—	—	—	—	—
S. District.	Newington - -	115,804	1	—	1	1	2	—	1	—	1	—	2	—
S. District.	St. Olave, Southwark -	12,723	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Bermondsey - - -	84,682	3	—	3	—	1	—	1	—	2	—	1	—
S. District.	Rotherhithe - - -	39,255	2	—	1	—	1	1	—	1	—	—	—	—
S. District.	Lambeth - - -	275,203	1	—	—	—	1	—	5	—	5	—	4	—
S. District.	Battersea - - -	150,558	3	1	—	—	2	—	2	—	1	—	1	—
S. District.	Wandsworth - -	156,942	—	—	1	—	—	—	5	—	—	—	1	—
S. District.	Camberwell - - -	235,344	1	—	3	1	2	1	4	1	6	—	1	—
S. District.	Greenwich - - -	165,413	—	1	—	—	1	—	1	—	4	1	2	1
S. District.	Lewisham - - -	92,647	—	1	3	—	—	—	1	—	1	—	—	—
S. District.	Woolwich - - -	40,848	—	—	1	—	—	—	—	—	—	—	—	—
S. District.	Plumstead - - -	52,436	1	1	—	—	1	—	—	—	—	—	—	—
S. District.	Lee - - - -	36,103	1	—	—	—	1	—	—	—	1	—	—	—
S. District.	Port of London - -	—	—	—	—	—	—	—	—	—	1	—	—	—

[a] Totals of actual *notifications.*
[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

Enteric Fever—*continued.*																
Weekly Statement, 2nd Quarter, 1896—*continued.*														Totals for 2nd Quarter, 1896.		Sanitary Areas.
May 16.		May 23.		May 30.		June 6.		June 13.		June 20.		June 27.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
48	8	41	4	39	8	35	7	46	3	25	9	44	5	527	79	London.
47	—	*38*	—	*34*	—	*30*	—	*42*	—	*25*	—	*43*	—	*501*	—	(*Administrative County.*)
1	1	—	—	1	—	—	—	1	—	1	1	1	1	11	3	Kensington.
—	—	1	—	1	—	—	—	—	—	1	—	1	—	6	2	Fulham.
—	—	1	—	2	1	—	—	2	—	—	—	1	—	11	3	Hammersmith.
—	—	—	—	—	—	—	1	—	—	—	—	—	—	11	3	Paddington.
1	—	—	—	1	—	2	1	—	—	1	1	1	—	9	2	Chelsea.
—	—	—	—	1	—	—	—	—	—	1	—	—	—	5	1	St. George, Hanover Sq.*
—	—	—	—	—	1	—	—	2	—	—	—	—	—	5	2	Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. James, Westminster.
1	—	3	1	5	—	4	—	—	—	—	—	—	—	22	2	St. Marylebone.
3	—	1	—	1	—	—	—	—	—	—	—	1	—	12	1	Hampstead.
1	—	1	—	—	—	1	—	3	—	3	1	2	—	19	4	St. Pancras.
7	1	8	—	—	1	3	1	3	—	—	—	3	—	39	5	Islington.
—	—	1	—	1	1	—	—	—	—	—	—	—	—	2	1	St. Mary, Stoke Newington.
6	—	—	—	—	—	1	2	1	1	1	1	—	—	21	6	Hackney.
—	—	2	—	—	—	—	—	—	—	—	1	—	—	4	1	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	—	Strand.†
1	—	1	—	—	—	—	—	—	—	—	—	—	—	5	1	Holborn.‡
1	1	1	—	1	—	2	—	1	—	—	—	2	—	14	1	Clerkenwell.
1	—	1	—	1	1	—	—	—	—	2	—	1	—	6	1	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	2	—	—	—	—	—	3	1	London, City of.§
1	—	3	—	—	—	2	—	1	—	—	1	2	—	25	4	Shoreditch.
2	1	3	—	—	—	1	—	—	—	—	—	5	—	20	2	Bethnal Green.
—	—	—	—	1	—	1	—	—	—	1	—	—	—	9	—	Whitechapel.||
1	—	—	1	1	—	1	—	—	—	1	—	—	—	7	1	St. George-in-the-East.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	3	—	Limehouse.
1	—	—	—	1	—	—	—	1	—	—	—	1	—	18	—	Mile End Old Town.
1	—	2	—	6	—	2	—	4	—	—	1	4	1	29	2	Poplar.
—	—	—	—	—	—	—	—	1	—	—	—	—	1	1	1	St. Saviour, Southwark.
1	—	1	—	—	—	1	—	1	—	—	—	2	—	8	—	St. George, Southwark.
3	—	1	—	2	1	1	—	2	1	2	—	2	1	21	4	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Olave, Southwark.
3	—	2	1	3	—	4	—	2	1	—	—	1	—	26	2	Bermondsey.
—	—	2	—	3	1	2	—	—	—	—	—	—	—	11	3	Rotherhithe.
2	1	1	1	—	—	2	—	3	—	2	1	4	—	30	3	Lambeth.
1	—	—	—	1	—	1	1	2	—	2	—	1	—	17	2	Battersea.
3	1	1	—	2	—	—	1	2	—	2	—	2	—	19	2	Wandsworth.
—	1	4	—	1	—	4	—	8	—	2	1	3	1	39	6	Camberwell.
1	—	—	—	1	—	—	—	—	—	1	—	—	—	11	3	Greenwich.
3	1	—	—	—	—	—	—	2	—	—	—	1	—	11	2	Lewisham.
—	—	—	—	1	—	—	—	—	—	1	—	—	—	3	—	Woolwich.
2	—	—	—	1	1	—	—	1	—	—	—	1	—	7	2	Plumstead.
—	—	—	—	—	—	—	—	—	—	1	—	—	—	4	—	Lee.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

§ Including Inner Temple (population, 96). || Including Tower of London (population, 868).

District	Sanitary Areas.	Population (1891).	ENTERIC FEVER—*continued.* Weekly Statement, 3rd Quarter, 1896. July 4. Cases.	July 4. Deaths.	July 11. Cases.	July 11. Deaths.	July 18. Cases.	July 18. Deaths.	July 25. Cases.	July 25. Deaths.	Aug. 1. Cases.	Aug. 1. Deaths.	Aug. 8. Cases.	Aug. 8. Deaths.
	London - - -	4,232,118	[a]52	10	33	5	46	2	71	9	88	11	71	10
	(*Administrative County*) -	- -	[b]*47*	—	*32*	—	*46*	—	*69*	—	*84*	—	*64*	—
W. District.	Kensington - - -	166,308	—	—	1	—	1	1	4	—	3	—	2	—
W. District.	Fulham - - -	91,639	2	—	—	—	1	—	1	—	1	—	—	—
W. District.	Hammersmith - -	97,239	1	—	—	—	—	—	—	—	—	—	3	—
W. District.	Paddington - - -	117,846	—	—	1	—	—	—	—	—	4	1	1	—
W. District.	Chelsea - - -	96,253	1	—	2	—	—	—	5	—	4	—	—	—
W. District.	St. George, Hanover Sq.* -	78,599	3	—	—	—	—	—	1	—	2	—	2	—
W. District.	Westminster - -	55,539	2	—	—	—	—	—	3	—	6	2	2	—
W. District.	St. James, Westminster -	24,995	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Marylebone - -	142,404	2	1	2	1	1	—	—	—	2	—	2	—
N. District.	Hampstead - - -	68,416	1	—	1	—	—	—	—	—	2	—	1	—
N. District.	St. Pancras - - -	234,379	3	1	2	—	4	—	8	2	8	—	7	2
N. District.	Islington - - -	319,143	2	—	1	—	3	—	3	3	3	—	6	—
N. District.	St. Mary, Stoke Newington	30,936	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	Hackney - - -	198,606	3	1	1	1	5	—	7	1	3	2	5	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	1	—	—	—	—	—	—	—	—	—
Central District.	St. Martin-in-the-Fields -	14,616	1	—	—	—	2	—	—	—	—	—	1	—
Central District.	Strand† - - -	25,217	—	—	—	—	1	—	—	—	—	1	—	—
Central District.	Holborn‡ - - -	043	—	—	—	—	—	—	1	—	1	—	2	—
Central District.	Clerkenwell - - -	66,216	—	—	—	1	3	—	1	—	2	—	—	—
Central District.	St. Luke, Middlesex -	42,440	2	—	—	—	1	—	1	—	1	—	1	—
Central District.	London, City of§ - -	37,583	—	—	—	—	2	—	—	—	—	—	—	—
E. District.	Shoreditch - - -	124,009	1	1	1	—	2	—	5	1	3	—	4	1
E. District.	Bethnal Green - -	129,132	4	—	2	—	—	—	3	1	2	—	3	—
E. District.	Whitechapel‖ - -	74,420	—	1	1	—	—	—	3	—	2	—	—	—
E. District.	St. George-in-the-East -	45,795	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Limehouse - - -	57,376	—	1	1	—	—	—	1	—	1	—	1	—
E. District.	Mile End Old Town -	107,592	—	—	—	—	3	—	—	—	3	1	3	—
E. District.	Poplar - - -	166,748	7	1	2	1	2	—	3	—	6	—	4	—
S. District.	St. Saviour, Southwark -	27,177	—	—	—	—	—	—	1	—	—	—	—	—
S. District.	St. George, Southwark -	59,712	2	—	—	—	2	—	1	—	1	—	1	1
S. District.	Newington - - -	115,804	2	—	1	—	1	—	3	—	3	1	—	1
S. District.	St. Olave, Southwark -	12,723	2	—	—	—	—	—	—	—	—	—	—	—
S. District.	Bermondsey - - -	84,682	—	—	1	—	1	—	1	—	—	—	—	—
S. District.	Rotherhithe - - -	39,255	—	—	—	—	—	—	—	—	1	—	2	1
S. District.	Lambeth - - -	275,203	4	—	2	—	4	1	3	—	5	2	4	—
S. District.	Battersea - - -	150,558	1	1	2	—	2	—	1	1	2	—	2	1
S. District.	Wandsworth - -	156,942	1	1	1	—	—	—	2	—	1	—	3	1
S. District.	Camberwell - - -	235,344	2	1	1	1	2	—	2	—	5	1	1	1
S. District.	Greenwich - - -	165,413	2	—	4	—	3	—	1	—	1	—	2	—
S. District.	Lewisham - - -	92,647	1	—	1	—	—	—	3	—	3	—	2	1
S. District.	Woolwich - - -	40,848	—	—	—	—	—	—	1	—	1	—	—	—
S. District.	Plumstead - - -	52,436	—	—	—	—	—	—	1	—	4	—	3	—
S. District.	Lee - - -	36,103	—	—	—	—	—	—	—	—	2	—	—	—
S. District.	Port of London - -	—	—	—	1	—	—	—	1	—	—	—	1	—

[a] Totals of actual *notifications.*
[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

Enteric Fever—*continued.*																
Weekly Statement, 3rd Quarter, 1896—*continued.*														Totals for 3rd Quarter, 1896.		Sanitary Areas.
Aug. 15.		Aug. 22.		Aug. 29.		Sept. 5.		Sept. 12.		Sept. 19.		Sept. 26.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
84	17	82	8	96	11	103	14	133	12	105	22	85	17	1,049	148	London.
81	—	*77*	—	*91*	—	*99*	—	*123*	—	*89*	—	*79*	—	*981*	—	(*Administrative County.*)
7	—	—	—	2	—	1	1	2	—	3	—	2	—	28	2	Kensington.
—	—	—	—	2	—	2	—	1	—	2	—	1	1	13	1	Fulham.
4	—	1	—	1	—	—	1	2	—	1	—	—	—	13	1	Hammersmith.
1	—	2	—	—	—	—	—	2	—	—	—	—	—	11	1	Paddington.
4	1	2	—	—	—	1	—	1	—	2	—	1	—	23	1	Chelsea.
—	—	2	1	2	—	—	—	—	—	2	1	1	—	15	2	St. George, Hanover Sq.*
—	2	—	—	—	—	—	—	—	—	—	—	1	—	14	4	Westminster.
—	—	—	—	—	—	1	—	—	—	—	—	—	—	1	—	St. James, Westminster.
2	—	4	—	5	2	2	—	6	1	2	—	3	—	33	5	St. Marylebone.
—	—	—	—	2	—	1	1	3	—	2	1	—	—	13	2	Hampstead.
7	—	3	1	7	—	7	1	15	2	13	1	6	2	90	12	St. Pancras.
4	1	9	—	9	1	16	2	16	1	17	5	8	1	97	14	Islington.
—	—	—	—	1	—	1	—	1	—	—	—	—	—	3	—	St. Mary, Stoke Newington.
6	1	10	—	4	2	5	—	6	—	7	1	6	1	68	10	Hackney.
—	—	—	—	2	—	—	—	3	—	—	1	—	—	6	1	St. Giles and St. George, Bloomsbury.
—	1	—	—	—	—	1	—	—	—	—	—	1	—	6	1	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	Strand.†
2	—	—	—	2	—	3	1	—	1	—	—	—	—	11	2	Holborn.‡
—	1	—	—	2	—	—	1	2	—	1	—	—	1	11	4	Clerkenwell.
—	—	2	—	1	—	3	—	1	—	—	—	—	1	13	1	St. Luke, Middlesex.
—	—	—	—	—	—	1	—	3	—	—	2	—	—	6	2	London, City of.§
3	—	3	1	4	—	5	1	4	1	4	—	5	—	44	6	Shoreditch.
1	1	—	—	5	—	4	1	12	1	5	1	—	—	41	5	Bethnal Green.
3	—	3	—	3	—	1	—	2	—	1	1	1	—	20	2	Whitechapel.‖
—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	—	St. George-in-the-East.
1	—	—	—	—	—	1	—	1	—	2	1	—	—	9	2	Limehouse.
5	—	5	1	8	—	7	—	6	2	2	—	2	1	44	5	Mile End Old Town.
3	2	5	1	7	1	4	—	8	—	6	—	11	1	68	7	Poplar.
—	—	—	—	—	—	—	—	—	—	1	—	—	—	2	—	St. Saviour, Southwark.
2	—	—	—	—	—	2	—	3	—	1	—	4	1	19	2	St. George, Southwark.
1	—	3	1	4	—	5	—	6	1	4	1	2	1	35	6	Newington.
—	—	—	—	—	—	—	—	—	—	1	—	1	—	4	—	St. Olave, Southwark.
1	1	—	—	3	—	3	—	1	—	1	—	2	—	14	1	Bermondsey.
1	—	—	—	—	—	2	—	2	—	5	1	3	1	16	3	Rotherhithe.
6	1	7	—	4	1	2	—	6	1	2	2	4	1	53	9	Lambeth.
—	—	5	—	1	2	5	—	2	—	3	—	7	—	33	5	Battersea.
3	1	2	—	1	—	3	1	2	—	—	1	3	1	22	6	Wandsworth.
7	2	4	1	7	1	5	1	6	1	4	1	2	2	48	13	Camberwell.
1	—	6	1	4	—	4	1	3	—	4	1	7	1	42	4	Greenwich.
6	1	2	—	—	1	3	—	—	—	2	—	—	—	23	3	Lewisham.
1	—	—	—	1	—	1	1	—	—	1	—	—	—	6	1	Woolwich.
2	1	—	—	1	—	1	—	1	—	1	—	—	—	14	1	Plumstead.
—	—	1	—	—	—	—	—	1	—	3	—	1	—	8	—	Lee.
—	—	1	—	1	—	—	—	2	—	—	—	—	—	7	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).
§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

District	Sanitary Areas.	Population (1891).	Oct. 3. Cases.	Oct. 3. Deaths.	Oct. 10. Cases.	Oct. 10. Deaths.	Oct. 17. Cases.	Oct. 17. Deaths.	Oct. 24. Cases.	Oct. 24. Deaths.	Oct. 31. Cases.	Oct. 31. Deaths.	Nov. 7. Cases.	Nov. 7. Deaths.	Nov. 14. Cases.	Nov. 14. Deaths.
	ENTERIC FEVER—*continued.* Weekly Statement, 4th Quarter, 1896.															
	London - - -	4,232,118	[a]115	13	92	17	88	17	79	9	81	26	94	15	90	16
	(*Administrative County*) -	- -	[b]*103*	—	*88*	—	*83*	—	*75*	—	*80*	—	*90*	—	*88*	—
W. District.	Kensington - - -	166,308	3	—	2	—	3	1	2	—	5	2	7	1	4	1
W. District.	Fulham - - -	91,639	2	—	2	—	3	1	4	2	1	—	3	—	5	—
W. District.	Hammersmith - -	97,239	4	—	—	1	3	—	—	—	—	1	1	1	3	—
W. District.	Paddington - - -	117,846	6	—	1	—	—	—	1	—	1	—	2	—	4	—
W. District.	Chelsea - - -	96,253	2	—	1	1	4	—	—	—	—	—	—	—	1	—
W. District.	St. George, Hanover Sq.* -	78,599	—	—	—	—	4	—	—	—	3	—	1	—	4	—
W. District.	Westminster - -	55,539	1	—	—	—	3	—	3	1	1	1	2	—	—	—
W. District.	St. James, Westminster -	24,995	—	—	1	—	—	—	—	—	—	1	—	1	—	—
N. District.	St. Marylebone - -	142,404	6	—	7	1	2	—	5	—	1	2	1	—	2	1
N. District.	Hampstead - - -	68,416	2	—	—	—	—	—	—	—	2	—	5	—	—	—
N. District.	St. Pancras - - -	234,379	9	1	6	2	4	1	3	2	7	2	4	2	4	1
N. District.	Islington - - -	319,143	15	1	6	1	3	2	9	1	7	2	4	1	5	1
N. District.	St. Mary, Stoke Newington	30,936	—	—	3	—	2	—	1	—	1	2	—	—	—	—
N. District.	Hackney - - -	198,606	2	—	7	2	6	—	4	—	9	3	7	1	3	2
Central District.	St. Giles and St. George, Bloomsbury.	39,782	1	—	—	—	1	—	—	—	1	—	—	—	—	—
Central District.	St. Martin-in-the-Fields -	14,616	—	—	1	1	1	—	—	—	—	—	1	—	1	—
Central District.	Strand† - - -	25,217	—	—	1	—	—	—	1	—	—	—	—	—	1	—
Central District.	Holborn‡ - - -	34,043	1	—	1	—	1	1	—	—	1	—	1	—	3	—
Central District.	Clerkenwell - - -	66,216	1	1	1	—	1	1	5	—	2	1	1	1	1	—
Central District.	St. Luke, Middlesex -	42,440	1	—	1	—	1	—	—	1	1	—	2	—	1	—
Central District.	London, City of § - -	37,583	—	1	—	—	—	—	—	—	—	—	—	—	2	—
E. District.	Shoreditch - - -	124,009	6	—	4	1	2	—	2	—	2	1	3	—	4	—
E. District.	Bethnal Green - -	129,132	8	2	5	1	6	2	2	—	1	—	1	—	4	—
E. District.	Whitechapel‖ - -	74,420	1	—	—	—	3	—	4	—	1	2	4	—	1	—
E. District.	St. George-in-the-East -	45,795	2	—	—	—	2	1	—	—	2	—	3	—	—	—
E. District.	Limehouse - - -	57,376	—	—	—	—	1	—	2	—	—	—	—	1	—	—
E. District.	Mile End Old Town -	107,592	2	—	4	—	1	—	1	—	3	—	2	—	2	1
E. District.	Poplar - - -	166,748	3	—	2	—	4	1	4	—	7	1	3	—	3	2
S. District.	St. Saviour, Southwark -	27,177	1	—	—	—	1	—	—	—	—	—	1	—	—	—
S. District.	St. George, Southwark -	59,712	—	1	—	—	1	—	4	—	1	—	2	1	2	—
S. District.	Newington - - -	115,804	2	2	4	2	3	1	1	—	1	—	2	—	2	—
S. District.	St. Olave, Southwark -	12,723	—	—	—	—	2	1	—	—	1	—	—	—	—	—
S. District.	Bermondsey - - -	84,682	5	—	1	—	—	—	3	—	1	1	2	2	—	—
S. District.	Rotherhithe - - -	39,255	1	1	2	—	—	—	1	—	—	—	—	—	—	—
S. District.	Lambeth - - -	275,203	3	—	6	—	6	—	2	1	5	1	9	—	5	2
S. District.	Battersea - - -	150,558	1	2	4	—	2	—	—	—	2	—	3	—	1	—
S. District.	Wandsworth - -	156,942	4	—	5	1	2	1	4	—	1	—	3	—	6	1
S. District.	Camberwell - - -	235,344	10	1	2	—	2	—	5	—	2	1	7	1	5	1
S. District.	Greenwich - - -	165,413	6	—	7	3	2	3	2	1	3	2	1	2	6	1
S. District.	Lewisham - - -	92,647	2	—	2	—	3	—	1	—	1	—	4	—	1	1
S. District.	Woolwich - - -	40,848	1	—	—	—	2	—	—	—	3	—	1	—	1	1
S. District.	Plumstead - - -	52,436	—	—	1	—	—	—	—	—	—	—	—	—	2	—
S. District.	Lee - - - -	36,103	—	—	—	—	1	—	2	—	1	—	1	—	1	—
S. District.	Port of London -	—	1	—	2	—	—	—	1	—	—	—	—	—	—	—

[a] Totals of actual *notifications.*
[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

Enteric Fever—*continued.*																		
Weekly Statement, 4th Quarter, 1896—*continued.*												Jan. 2, 1897.		Totals for 4th Quarter, 1896.		Grand Totals for Year 1896.		Sanitary Areas.
Nov. 21.		Nov. 28.		Dec. 5.		Dec. 12.		Dec. 19.		Dec. 26.								
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
88	18	60	17	72	8	61	12	71	15	29	9	81	12	1,101	204	3,394	564	London.
82	—	*58*	—	*69*	—	*57*	—	*68*	—	*28*	—	*81*	—	*1,050*	—	*3,200*	—	(*Administrative County.*)
2	—	2	1	3	—	2	1	2	1	1	—	9	1	47	9	100	16	Kensington.
3	1	—	—	1	—	1	—	2	1	—	—	2	—	29	5	58	9	Fulham.
—	—	2	—	3	—	2	1	1	1	—	—	1	—	20	5	53	13	Hammersmith.
7	1	1	—	1	1	1	—	1	1	—	—	4	1	30	4	68	13	Paddington.
2	—	1	2	1	—	2	—	2	—	2	—	1	1	19	4	69	10	Chelsea.
2	1	1	—	2	—	2	—	1	1	1	—	2	—	23	2	59	9	St. George, Hanover Sq.*
—	—	—	—	—	—	1	—	—	—	—	—	2	—	13	2	40	9	Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	2	2	5	3	St. James, Westminster.
1	1	4	1	5	1	—	—	4	—	1	1	2	1	41	9	118	20	St. Marylebone.
4	—	1	1	1	—	1	1	1	—	1	—	2	—	20	2	58	7	Hampstead.
6	—	4	—	3	—	3	1	2	1	—	—	7	1	62	14	215	31	St. Pancras.
6	1	5	1	4	—	5	—	8	1	—	2	5	1	82	15	258	47	Islington.
1	—	—	—	—	—	—	—	—	—	—	—	—	—	8	2	17	5	St. Mary, Stoke Newington.
4	3	4	1	3	2	9	1	8	1	1	1	4	1	71	18	212	37	Hackney.
—	—	2	—	1	—	2	1	—	—	—	—	1	—	9	1	25	4	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	1	—	—	—	—	—	5	1	18	3	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	8	1	Strand.†
1	1	—	—	2	—	—	—	2	—	—	—	1	—	14	2	33	5	Holborn.‡
3	—	2	1	2	1	1	—	1	1	1	—	1	—	23	7	70	15	Clerkenwell.
—	—	—	—	2	—	—	1	—	—	—	—	—	—	9	2	41	4	St. Luke, Middlesex.
—	—	—	—	1	1	1	—	3	—	1	—	—	—	8	2	24	10	London, City of.§
1	1	4	1	—	—	1	—	1	—	—	—	—	—	30	4	120	17	Shoreditch.
2	1	3	—	2	—	—	—	5	1	—	—	1	—	40	7	134	20	Bethnal Green.
3	1	1	—	1	—	—	1	1	—	—	—	3	—	23	4	64	9	Whitechapel.‖
1	—	—	—	3	—	1	—	—	—	—	1	5	—	19	2	35	5	St. George-in-the-East.
2	—	—	—	—	—	1	—	2	—	—	—	—	—	8	1	28	3	Limehouse.
2	—	—	—	2	1	2	1	3	1	1	1	5	1	30	6	123	16	Mile End Old Town.
15	1	3	3	2	—	5	1	—	—	2	—	2	—	55	9	197	26	Poplar.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	4	—	10	1	St. Saviour, Southwark.
2	—	2	—	3	—	—	—	—	1	—	—	1	—	18	3	52	7	St. George, Southwark.
1	—	1	—	3	—	1	—	1	—	2	—	2	—	26	5	89	18	Newington.
—	1	—	—	—	—	—	—	—	—	2	—	—	—	5	2	10	2	St. Olave, Southwark.
1	—	2	—	—	—	—	—	2	—	—	—	1	—	18	3	69	11	Bermondsey.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	1	61	11	Rotherhithe.
4	1	5	—	7	—	2	1	2	—	2	1	5	—	63	7	172	24	Lambeth.
2	—	3	3	3	—	3	—	5	—	4	1	3	2	36	8	115	16	Battersea.
1	—	1	1	3	1	3	—	1	1	—	—	3	—	37	6	107	21	Wandsworth.
4	—	3	—	1	—	2	—	4	—	1	—	3	1	51	5	179	37	Camberwell.
1	2	2	—	4	—	2	1	2	1	2	1	—	1	40	18	118	32	Greenwich.
1	1	—	1	1	—	2	—	2	1	1	—	—	—	21	4	65	9	Lewisham.
—	—	—	—	—	—	1	—	—	—	—	—	—	—	9	1	21	2	Woolwich.
—	—	—	—	—	—	—	—	—	—	2	—	—	—	5	—	29	4	Plumstead.
1	—	—	—	1	—	2	—	1	—	—	—	1	—	12	—	30	2	Lee.
2	—	1	—	1	—	—	—	—	—	1	—	—	—	9	—	17	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

§ Including Inner Temple (population, 96).

‖ Including Tower of London (population, 868).

Sanitary Areas.		Population (1891).	Simple Continued Fever. Weekly Statement, 1st Quarter, 1896. Jan. 4. Cases.	Jan. 4. Deaths.	Jan. 11. Cases.	Jan. 11. Deaths.	Jan. 18. Cases.	Jan. 18. Deaths.	Jan. 25. Cases.	Jan. 25. Deaths.	Feb. 1. Cases.	Feb. 1. Deaths.	Feb. 8. Cases.	Feb. 8. Deaths.
London		4,232,118	[a]5	—	2	1	1	1	2	—	1	—	2	—
(*Administrative County*)		-	[b]5	—	*2*	—	*1*	—	*2*	—	*1*	—	*2*	—
W. District.	Kensington	166,308	—	—	—	—	—	—	—	—	1	—	—	—
	Fulham	91,639	—	—	—	—	—	—	—	—	—	—	—	—
	Hammersmith	97,239	—	—	1	—	—	—	—	—	—	—	—	—
	Paddington	117,846	—	—	—	—	1	1	—	—	—	—	—	—
	Chelsea	96,253	—	—	—	—	—	—	—	—	—	—	—	—
	St. George, Hanover Sq.*	78,599	—	—	—	—	—	—	—	—	—	—	—	—
	Westminster	55,539	—	—	—	—	—	—	—	—	—	—	—	—
	St. James, Westminster	24,995	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Marylebone	142,404	—	—	—	—	—	—	—	—	—	—	—	—
	Hampstead	68,416	—	—	—	—	—	—	—	—	—	—	—	—
	St. Pancras	234,379	—	—	—	—	—	—	—	—	—	—	—	—
	Islington	319,143	—	—	—	—	—	—	—	—	—	—	1	—
	St. Mary, Stoke Newington	30,936	—	—	—	—	—	—	—	—	—	—	—	—
	Hackney	198,606	1	—	1	—	—	—	1	—	—	—	—	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	—	—	—	—	—	—	—	—
	St. Martin-in-the-Fields	14,616	—	—	—	—	—	—	—	—	—	—	—	—
	Strand†	25,217	—	—	—	—	—	—	—	—	—	—	—	—
	Holborn‡	34,043	—	—	—	—	—	—	—	—	—	—	—	—
	Clerkenwell	66,216	—	—	—	—	—	—	—	—	—	—	—	—
	St. Luke, Middlesex	42,440	—	—	—	—	—	—	—	—	—	—	—	—
	London, City of§	37,583	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Shoreditch	124,009	—	—	—	—	—	—	—	—	—	—	—	—
	Bethnal Green	129,132	1	—	—	1	—	—	—	—	—	—	—	—
	Whitechapel‖	74,420	—	—	—	—	—	—	—	—	—	—	—	—
	St. George-in-the-East	45,795	1	—	—	—	—	—	—	—	—	—	—	—
	Limehouse	57,376	—	—	—	—	—	—	—	—	—	—	—	—
	Mile End Old Town	107,592	1	—	—	—	—	—	—	—	—	—	—	—
	Poplar	166,748	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	St. Saviour, Southwark	27,177	—	—	—	—	—	—	—	—	—	—	—	—
	St. George, Southwark	59,712	—	—	—	—	—	—	—	—	—	—	—	—
	Newington	115,804	—	—	—	—	—	—	—	—	—	—	—	—
	St. Olave, Southwark	12,723	—	—	—	—	—	—	—	—	—	—	—	—
	Bermondsey	84,682	—	—	—	—	—	—	—	—	—	—	—	—
	Rotherhithe	39,255	—	—	—	—	—	—	—	—	—	—	—	—
	Lambeth	275,203	1	—	—	—	—	—	1	—	—	—	—	—
	Battersea	150,558	—	—	—	—	—	—	—	—	—	—	—	—
	Wandsworth	156,942	—	—	—	—	—	—	—	—	—	—	1	—
	Camberwell	235,344	—	—	—	—	—	—	—	—	—	—	—	—
	Greenwich	165,413	—	—	—	—	—	—	—	—	—	—	—	—
	Lewisham	92,647	—	—	—	—	—	—	—	—	—	—	—	—
	Woolwich	40,848	—	—	—	—	—	—	—	—	—	—	—	—
	Plumstead	52,436	—	—	—	—	—	—	—	—	—	—	—	—
	Lee	36,103	—	—	—	—	—	—	—	—	—	—	—	—
	Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—

[a] Totals of actual *notifications*.
Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

Simple Continued Fever—*continued.*																
Weekly Statement, 1st Quarter, 1896—*continued.*														Totals for 1st Quarter, 1896.		Sanitary Areas.
Feb. 15.		Feb. 22.		Feb. 29.		Mar. 7.		Mar. 14.		Mar. 21.		Mar. 28.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
3	—	2	1	—	—	1	1	—	—	—	—	2	—	21	4	London.
3	—	*2*	—	—	—	*1*	—	—	—	—	—	*2*	—	*21*	—	(*Administrative County.*)
—	—	1	1	—	—	—	—	—	—	—	—	—	—	2	1	Kensington.
—	—	—	—	—	—	1	—	—	—	—	—	—	—	1	—	Fulham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Hammersmith.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	Paddington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Chelsea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George, Hanover Sq.*
—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. James, Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Marylebone.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hampstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Pancras.
1	—	—	—	—	—	—	1	—	—	—	—	1	—	3	1	Islington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Mary, Stoke Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	Hackney.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Strand.†
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Holborn.‡
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Clerkenwell.
1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	London, City of.§
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Shoreditch.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	Bethnal Green.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Whitechapel.‖
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	St. George-in-the-East.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Limehouse.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Mile End Old Town.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Poplar.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Saviour, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Olave, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Bermondsey.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Rotherhithe.
1	—	1	—	—	—	—	—	—	—	—	—	—	—	4	—	Lambeth.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Battersea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Wandsworth.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Camberwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Greenwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lewisham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Woolwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lee.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).
§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 838).

District	Sanitary Areas.	Population (1891).	Simple Continued Fever—*continued.* Weekly Statement, 2nd Quarter, 1896. April 4. Cases.	April 4. Deaths.	April 11. Cases.	April 11. Deaths.	April 18. Cases.	April 18. Deaths.	April 25. Cases.	April 25. Deaths.	May 2. Cases.	May 2. Deaths.	May 9. Cases.	May 9. Deaths.
	London	4,232,118	[a]3	—	1	—	2	1	—	—	1	—	—	—
	(*Administrative County*)	—	[b]*3*	—	*1*	—	*1*	—	—	—	*1*	—	—	—
W. District.	Kensington	166,308	—	—	—	—	—	—	—	—	—	—	—	—
W. District.	Fulham	91,639	—	—	—	—	—	—	—	—	—	—	—	—
W. District.	Hammersmith	97,239	—	—	—	—	—	—	—	—	—	—	—	—
W. District.	Paddington	117,846	—	—	—	—	—	—	—	—	—	—	—	—
W. District.	Chelsea	96,253	—	—	—	—	—	—	—	—	—	—	—	—
W. District.	St. George, Hanover Sq.*	78,599	—	—	—	—	—	—	—	—	—	—	—	—
W. District.	Westminster	55,539	—	—	—	—	—	—	—	—	—	—	—	—
W. District.	St. James, Westminster	24,995	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Marylebone	142,404	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	Hampstead	68,416	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Pancras	234,379	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	Islington	319,143	1	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Mary, Stoke Newington	30,936	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	Hackney	198,606	1	—	—	—	—	—	—	—	—	—	—	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	St. Martin-in-the-Fields	14,616	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	Strand†	25,217	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	Holborn‡	34,043	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	Clerkenwell	66,216	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	St. Luke, Middlesex	42,440	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	London, City of§	37,583	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Shoreditch	124,009	1	—	—	—	—	—	—	—	—	—	—	—
E. District.	Bethnal Green	129,132	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Whitechapel‖	74,420	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	St. George-in-the-East	45,795	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Limehouse	57,376	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Mile End Old Town	107,592	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Poplar	166,748	—	—	—	—	2	—	—	—	—	—	—	—
S. District.	St. Saviour, Southwark	27,177	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	St. George, Southwark	59,712	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Newington	115,804	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	St. Olave, Southwark	12,723	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Bermondsey	84,682	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Rotherhithe	39,255	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Lambeth	275,203	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Battersea	150,558	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Wandsworth	156,942	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Camberwell	235,344	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Greenwich	165,413	—	—	—	—	—	—	—	—	1	—	—	—
S. District.	Lewisham	92,647	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Woolwich	40,848	—	—	1	—	—	1	—	—	—	—	—	—
S. District.	Plumstead	52,436	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Lee	36,103	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—

[a] Totals of actual *notifications*.
[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

Simple Continued Fever—*continued.*																
Weekly Statement, 2nd Quarter, 1896—*continued.*														Totals for 2nd Quarter, 1896.		Sanitary Areas.
May 16.		May 23.		May 30.		June 6.		June 13.		June 20.		June 27.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
5	—	3	—	2	—	—	—	1	1	3	—	1	1	22	3	London.
4	—	*3*	—	*2*	—	—	—	*1*	—	*3*	—	*1*	—	*20*	—	(*Administrative County.*)
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Kensington.
1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Fulham.
—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	Hammersmith.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Paddington.
—	—	—	—	—	—	—	—	1	1	—	—	—	—	1	1	Chelsea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George, Hanover Sq.*
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. James, Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Marylebone.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hampstead.
—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	—	St. Pancras.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Islington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Mary, Stoke Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Hackney.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Martin-in-the Fields.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Strand.†
—	—	—	—	1	—	—	—	—	—	—	—	—	—	1	—	Holborn.‡
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Clerkenwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	London, City of.§
—	—	—	—	1	—	—	—	—	—	—	—	1	—	3	—	Shoreditch.
2	—	—	—	—	—	—	—	—	—	1	—	—	—	3	—	Bethnal Green.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Whitechapel.‖
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George-in-the-East.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Limehouse.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Mile End Old Town.
1	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	Poplar.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Saviour, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Olave, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Bermondsey.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Rotherhithe.
1	—	—	—	—	—	—	—	—	—	1	—	—	—	2	—	Lambeth.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Battersea.
—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	—	Wandsworth.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Camberwell.
—	—	1	—	—	—	—	—	—	—	—	—	—	—	2	—	Greenwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lewisham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	Woolwich
—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	—	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lee.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

§ Including Inner Temple (population, 96).

‖ Including Tower of London (population, 838).

Sanitary Areas.		Population (1891).	SIMPLE CONTINUED FEVER—*continued.* Weekly Statement, 3rd Quarter, 1896. July 4. Cases.	July 4. Deaths.	July 11. Cases.	July 11. Deaths.	July 18. Cases.	July 18. Deaths.	July 25. Cases.	July 25. Deaths.	Aug. 1. Cases.	Aug. 1. Deaths.	Aug. 8. Cases.	Aug. 8. Deaths.
London - - - -		4,232,118	[a]2	—	1	—	4	1	3	—	2	—	2	—
(*Administrative County*) -		- -	[b]*3*	—	*1*	—	*4*	—	*3*	—	*2*	—	*2*	—
W. District.	Kensington - - -	166,308	—	—	—	—	2	—	—	—	—	—	1	—
	Fulham - - -	91,639	—	—	—	—	1	—	—	—	—	—	—	—
	Hammersmith - -	97,239	1	—	—	—	—	—	—	—	—	—	—	—
	Paddington - - -	117,846	—	—	—	—	—	—	—	—	—	—	—	—
	Chelsea - - -	96,253	—	—	—	—	—	—	—	—	—	—	—	—
	St. George, Hanover Sq.* -	78,599	—	—	—	—	—	—	—	—	—	—	—	—
	Westminster - -	55,539	—	—	—	—	—	—	—	—	—	—	—	—
	St. James, Westminster -	24,995	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Marylebone - -	142,404	—	—	—	—	—	—	—	—	—	—	—	—
	Hampstead - - -	68,416	—	—	—	—	1	—	1	—	—	—	—	—
	St. Pancras - - -	234,379	—	—	—	—	—	—	—	—	—	—	—	—
	Islington - - -	319,143	—	—	—	—	—	—	—	—	1	—	—	—
	St. Mary, Stoke Newington	30,936	—	—	—	—	—	—	—	—	—	—	—	—
	Hackney - - -	198,606	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	—	—	—	—	—	—	—	—
	St. Martin-in-the-Fields -	14,616	—	—	—	—	—	—	—	—	—	—	1	—
	Strand† - - -	25,217	—	—	—	—	—	—	—	—	—	—	—	—
	Holborn‡ - - -	34,043	—	—	—	—	—	—	—	—	—	—	—	—
	Clerkenwell - - -	66,216	—	—	—	—	—	—	—	—	—	—	—	—
	St. Luke, Middlesex -	42,410	—	—	—	—	—	—	—	—	—	—	—	—
	London, City of§ - -	37,583	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Shoreditch - - -	124,009	—	—	—	—	—	—	—	—	—	—	—	—
	Bethnal Green - -	129,132	—	—	—	—	—	—	—	—	—	—	—	—
	Whitechapel‖ - -	74,420	—	—	—	—	—	—	—	—	—	—	—	—
	St. George-in-the-East -	45,795	—	—	—	—	—	—	—	—	—	—	—	—
	Limehouse - - -	57,376	—	—	—	—	—	—	—	—	—	—	—	—
	Mile End Old Town -	107,592	—	—	—	—	—	—	—	—	—	—	—	—
	Poplar - - -	166,748	—	—	—	—	—	—	1	—	1	—	—	—
S. District.	St. Saviour, Southwark -	27,177	—	—	—	—	—	—	—	—	—	—	—	—
	St. George, Southwark -	59,712	—	—	—	—	—	—	—	—	—	—	—	—
	Newington - - -	115,804	—	—	—	—	—	—	—	—	—	—	—	—
	St. Olave, Southwark -	12,723	—	—	—	—	—	—	—	—	—	—	—	—
	Bermondsey - -	84,682	—	—	—	—	—	—	—	—	—	—	—	—
	Rotherhithe - -	39,255	—	—	—	—	—	—	—	—	—	—	—	—
	Lambeth - - -	275,203	—	—	1	—	—	—	—	—	—	—	—	—
	Battersea - - -	150,558	—	—	—	—	—	1	—	—	—	—	—	—
	Wandsworth - -	156,942	—	—	—	—	—	—	—	—	—	—	—	—
	Camberwell - - -	235,344	—	—	—	—	—	—	—	—	—	—	—	—
	Greenwich - - -	165,413	—	—	—	—	—	—	—	—	—	—	—	—
	Lewisham - - -	92,647	—	—	—	—	—	—	—	—	—	—	—	—
	Woolwich - - -	40,848	1	—	—	—	—	—	—	—	—	—	—	—
	Plumstead - - -	52,456	—	—	—	—	—	—	1	—	—	—	—	—
	Lee - - - -	36,103	—	—	—	—	—	—	—	—	—	—	—	—
	Port of London -	—	—	—	—	—	—	—	—	—	—	—	—	—

[a] Totals of actual *notifications.*
[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

SIMPLE CONTINUED FEVER—*continued.*																
Weekly Statement, 3rd Quarter, 1896—*continued.*														Totals for 3rd Quarter, 1896.		Sanitary Areas.
Aug. 15.		Aug. 22.		Aug. 29.		Sept. 5.		Sept. 12.		Sept. 19.		Sept. 26.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
3	—	3	—	—	1	4	—	3	—	2	—	1	—	30	2	London.
3	—	*3*	—	—	—	*3*	—	*3*	—	*2*	—	*1*	—	*30*	—	(*Administrative County.*)
—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	Kensington.
—	—	1	—	—	—	—	—	—	—	1	—	—	—	3	—	Fulham.
—	—	—	—	—	—	1	—	—	—	—	—	—	—	2	—	Hammersmith.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Paddington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Chelsea.
—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	—	St. George, Hanover Sq.*
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. James, Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Marylebone.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	Hampstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Pancras.
—	—	—	—	—	—	—	—	—	—	1	—	—	—	2	—	Islington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Mary, Stoke Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hackney.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Strand.†
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Holborn.‡
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Clerkenwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	London, City of.§
1	—	—	—	—	—	2	—	—	—	—	—	1	—	4	—	Shoreditch.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Bethnal Green.
—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1	Whitechapel.‖
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George-in-the-East.
—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	—	Limehouse.
1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Mile End Old Town.
1	—	2	—	—	—	—	—	—	—	—	—	—	—	5	—	Poplar.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Saviour, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George, Southwark.
—	—	—	—	—	—	1	—	—	—	—	—	—	—	1	—	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Olave, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Bermondsey.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Rotherhithe.
—	—	—	—	—	—	—	—	1	—	—	—	—	—	2	—	Lambeth.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	Battersea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Wandsworth.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Camberwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Greenwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lewisham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Woolwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lee.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).
§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

	Sanitary Areas.	Population (1891).	Simple Continued Fever—*continued.* Weekly Statement, 4th Quarter, 1896. Oct. 3. Cases.	Oct. 3. Deaths.	Oct. 10. Cases.	Oct. 10. Deaths.	Oct. 17. Cases.	Oct. 17. Deaths.	Oct. 24. Cases.	Oct. 24. Deaths.	Oct. 31. Cases.	Oct. 31. Deaths.	Nov. 7. Cases.	Nov. 7. Deaths.	Nov. 14. Cases.	Nov. 14. Deaths.
	London - - - -	4,232,118	[a]—	—	7	—	3	1	5	1	2	—	2	—	—	—
	(*Administrative County*) -	- -	[b]—	—	*7*	—	*3*	—	*5*	—	*2*	—	*2*	—	—	—
W. District.	Kensington - - -	166,308	—	—	—	—	—	—	—	—	1	—	—	—	—	—
	Fulham - - -	91,639	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Hammersmith - -	97,239	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Paddington - - -	117,846	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Chelsea - - -	96,253	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. George, Hanover Sq.* -	78,599	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Westminster - -	55,539	—	—	—	—	—	—	1	—	—	—	—	—	—	—
	St. James, Westminster -	24,995	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Marylebone - -	142,404	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Hampstead - - -	68,416	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Pancras - - -	234,379	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Islington - - -	319,143	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Mary, Stoke Newington	30,936	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Hackney - -	198,606	—	—	1	—	—	1	—	—	—	—	—	—	—	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Martin-in-the-Fields -	14,616	—	—	—	—	—	—	1	—	—	—	—	—	—	—
	Strand† - - -	25,217	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Holborn‡ - - -	34,043	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Clerkenwell - - -	66,216	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Luke, Middlesex -	42,440	—	—	1	—	—	—	—	—	—	—	—	—	—	—
	London, City of§ - -	37,583	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Shoreditch - - -	124,009	—	—	1	—	—	—	1	—	—	—	—	—	—	—
	Bethnal Green - -	129,132	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Whitechapel‖ - -	74,420	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. George-in-the-East -	45,795	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Limehouse - - -	57,376	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Mile End Old Town -	107,592	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Poplar - - -	166,748	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	St. Saviour, Southwark -	27,177	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. George, Southwark -	59,712	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Newington - - -	115,804	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Olave, Southwark -	12,723	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Bermondsey - -	84,682	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Rotherhithe - - -	39,255	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Lambeth - - -	275,203	—	—	1	—	—	—	1	—	1	—	1	—	—	—
	Battersea - - -	150,558	—	—	—	—	1	—	—	—	—	—	—	—	—	—
	Wandsworth - -	156,942	—	—	2	—	2	—	—	—	—	—	—	—	—	—
	Camberwell - - -	235,344	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Greenwich - - -	165,413	—	—	1	—	—	—	—	1	—	—	—	—	—	—
	Lewisham - - -	92,647	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Woolwich - - -	40,848	—	—	—	—	—	—	1	—	—	—	—	—	—	—
	Plumstead - - -	52,436	—	—	—	—	—	—	—	—	—	—	1	—	—	—
	Lee - - - -	36,103	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Port of London - -	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

[a] Totals of actual *notifications.*
[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

Simple Continued Fever—*continued.* Weekly Statement, 4th Quarter, 1896—*continued.* Nov. 21. Cases.	Nov. 21. Deaths.	Nov. 28. Cases.	Nov. 28. Deaths.	Dec. 5. Cases.	Dec. 5. Deaths.	Dec. 12. Cases.	Dec. 12. Deaths.	Dec. 19. Cases.	Dec. 19. Deaths.	Dec. 26. Cases.	Dec. 26. Deaths.	Jan. 2, 1897. Cases.	Jan. 2, 1897. Deaths.	Totals for 4th Quarter, 1896. Cases.	Totals for 4th Quarter, 1896. Deaths.	Grand Totals for Year 1896. Cases.	Grand Totals for Year 1896. Deaths.	Sanitary Areas.
1	—	6	—	1	—	4	1	3	—	—	—	—	1	34	4	107	13	London.
1	—	*6*	—	*1*	—	*4*	—	*3*	—	—	—	—	—	*34*	—	*105*	—	(*Administrative County.*)
—	—	—	—	—	—	—	—	1	—	—	—	—	—	2	—	7	1	Kensington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5	—	Fulham.
—	—	—	—	—	—	—	—	1	—	—	—	—	1	1	1	4	2	Hammersmith.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	Paddington.
—	—	—	—	1	—	—	—	—	—	—	—	—	—	1	—	2	1	Chelsea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	St. George, Hanover Sq.*
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	2	—	Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. James, Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Marylebone.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	Hampstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	St. Pancras.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6	1	Islington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Mary, Stoke Newington.
—	—	1	—	—	—	—	—	1	—	—	—	—	—	3	1	7	1	Hackney.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	2	—	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Strand.†
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Holborn.‡
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Clerkenwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	2	—	St. Luke, Middlesex.
—	—	—	—	—	—	1	—	—	—	—	—	—	—	1	—	1	—	London, City of.§
—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	9	—	Shoreditch.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	1	Bethnal Green.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	Whitechapel.‖
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	St. George-in-the-East.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Limehouse.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	Mile End Old Town.
—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	—	9	—	Poplar.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Saviour, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George, Southwark.
—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	—	2	—	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Olave, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Bermondsey.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Rotherhithe.
—	—	3	—	—	—	—	1	—	—	—	—	—	—	7	1	15	1	Lambeth.
—	—	—	—	—	—	1	—	—	—	—	—	—	—	2	—	2	1	Battersea.
1	—	—	—	—	—	2	—	—	—	—	—	—	—	7	—	9	—	Wandsworth.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Camberwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	3	1	Greenwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lewisham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	3	1	Woolwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	3	—	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lee.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

Sanitary Areas.		Population (1891).	Typhus Fever. Weekly Statement, 1896. Feb. 8. Deaths.	Mar. 14. Cases.	Totals for 1st Quarter, 1896. Cases.	Totals for 1st Quarter, 1896. Deaths.	Totals for 2nd Quarter, 1896. Cases.	Totals for 2nd Quarter, 1896. Deaths.	July 4. Deaths.	July 11. Cases.	July 11. Deaths.
London - - -		4,232,118	[a]1	1	1	1	—	—	2	1	1
(*Administrative County*) -		- -	[b]—	*1*	*1*	—	—	—	*2*	*1*	—
W. District.	Kensington - -	166,308	—	—	—	—	—	—	—	—	—
	Fulham - - -	91,639	—	—	—	—	—	—	—	—	—
	Hammersmith - -	97,239	—	—	—	—	—	—	—	—	—
	Paddington - -	117,846	—	—	—	—	—	—	—	—	—
	Chelsea - - -	96,253	—	—	—	—	—	—	—	—	—
	St. George, Hanover Sq.*	78,599	—	—	—	—	—	—	—	—	—
	Westminster - -	55,539	—	—	—	—	—	—	—	—	—
	St. James, Westminster -	24,995	—	—	—	—	—	—	—	—	—
N. District.	St. Marylebone - -	142,404	—	—	—	—	—	—	—	—	—
	Hampstead - -	68,416	—	—	—	—	—	—	—	—	—
	St. Pancras - -	234,379	—	—	—	—	—	—	—	—	—
	Islington - -	319,143	—	—	—	—	—	—	—	—	—
	St. Mary, Stoke Newington	30,936	—	—	—	—	—	—	—	—	—
	Hackney - -	198,606	—	—	—	—	—	—	—	—	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	—	—	—	—	—
	St. Martin-in-the-Fields -	14,616	—	—	—	—	—	—	—	—	—
	Strand† - - -	25,217	—	—	—	—	—	—	—	—	—
	Holborn‡ - - -	34,043	1	1	1	1	—	—	—	—	—
	Clerkenwell - -	66,216	—	—	—	—	—	—	—	—	1
	St. Luke, Middlesex -	42,440	—	—	—	—	—	—	—	—	—
	London, City of§ - -	37,583	—	—	—	—	—	—	—	—	—
E. District.	Shoreditch - -	124,009	—	—	—	—	—	—	—	—	—
	Bethnal Green - -	129,132	—	—	—	—	—	—	—	—	—
	Whitechapel‖ - -	74,420	—	—	—	—	—	—	—	—	—
	St. George-in-the-East -	45,795	—	—	—	—	—	—	—	—	—
	Limehouse - -	57,376	—	—	—	—	—	—	—	—	—
	Mile End Old Town -	107,592	—	—	—	—	—	—	—	—	—
	Poplar - - -	166,748	—	—	—	—	—	—	—	—	—
S. District.	St. Saviour, Southwark -	27,177	—	—	—	—	—	—	—	—	—
	St. George, Southwark -	59,712	—	—	—	—	—	—	—	—	—
	Newington - -	115,804	—	—	—	—	—	—	—	—	—
	St. Olave, Southwark -	12,723	—	—	—	—	—	—	—	—	—
	Bermondsey - -	84,682	—	—	—	—	—	—	—	—	—
	Rotherhithe - -	39,255	—	—	—	—	—	—	—	—	—
	Lambeth - - -	275,203	—	—	—	—	—	—	—	—	—
	Battersea - - -	150,558	—	—	—	—	—	—	—	—	—
	Wandsworth - -	156,942	—	—	—	—	—	—	—	—	—
	Camberwell - -	235,344	—	—	—	—	—	—	2	1	—
	Greenwich - -	165,413	—	—	—	—	—	—	—	—	—
	Lewisham - - -	92,647	—	—	—	—	—	—	—	—	—
	Woolwich - - -	40,848	—	—	—	—	—	—	—	—	—
	Plumstead - -	52,436	—	—	—	—	—	—	—	—	—
	Lee - - - -	36,103	—	—	—	—	—	—	—	—	—
	Port of London - -	—	—	—	—	—	—	—	—	—	—

[a] Totals of actual *notifications*.
[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population, 235).
† Including Middle Temple (population, 95).

Typhus Fever—*continued.*											
Weekly Statement, 1896—*continued.*									Grand Totals for Year 1896.		Sanitary Areas.
July 18.		Aug. 1.		Aug. 22.	Totals for 3rd Quarter, 1896.		Totals for 4th Quarter, 1896.				
Cases.	Deaths.	Cases.	Deaths.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
1	1	1	1	1	5	4	—	—	6	5	London.
1	—	*1*	—	—	*5*	—	—	—	*6*	—	(*Administrative County*).
—	—	—	—	—	—	—	—	—	—	—	Kensington.
—	—	—	—	—	—	—	—	—	—	—	Fulham.
1	1	—	—	—	1	1	—	—	1	1	Hammersmith.
—	—	—	—	—	—	—	—	—	—	—	Paddington.
—	—	—	—	—	—	—	—	—	—	—	Chelsea.
—	—	—	—	—	—	—	—	—	—	—	St. George, Hanover Sq.*
—	—	—	—	—	—	—	—	—	—	—	Westminster.
—	—	—	—	—	—	—	—	—	—	—	St. James, Westminster.
—	—	—	—	—	—	—	—	—	—	—	St. Marylebone.
—	—	—	—	—	—	—	—	—	—	—	Hampstead.
—	—	—	—	—	—	—	—	—	—	—	St. Pancras.
—	—	—	—	—	—	—	—	—	—	—	Islington.
—	—	—	—	—	—	—	—	—	—	—	St. Mary, Stoke Newington.
—	—	—	—	1	—	1	—	—	—	1	Hackney.
—	—	—	—	—	—	—	—	—	—	—	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	Strand.†
—	—	—	—	—	—	—	—	—	1	1	Holborn.‡
—	—	—	—	—	—	1	—	—	—	1	Clerkenwell.
—	—	—	—	—	—	—	—	—	—	—	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	—	—	—	London, City of.§
—	—	—	—	—	—	—	—	—	—	—	Shoreditch.
—	—	—	—	—	—	—	—	—	—	—	Bethnal Green.
—	—	—	—	—	—	—	—	—	—	—	Whitechapel.‖
—	—	—	—	—	—	—	—	—	—	—	St. George-in-the-East.
—	—	—	—	—	—	—	—	—	—	—	Limehouse.
—	—	—	—	—	—	—	—	—	—	—	Mile End Old Town.
—	—	—	—	—	—	—	—	—	—	—	Poplar.
—	—	—	—	—	—	—	—	—	—	—	St. Saviour, Southwark.
—	—	—	—	—	—	—	—	—	—	—	St. George, Southwark.
—	—	—	—	—	—	—	—	—	—	—	Newington.
—	—	—	—	—	—	—	—	—	—	—	St. Olave, Southwark.
—	—	—	—	—	—	—	—	—	—	—	Bermondsey.
—	—	—	—	—	—	—	—	—	—	—	Rotherhithe.
—	—	1	1	—	1	1	—	—	1	1	Lambeth.
—	—	—	—	—	—	—	—	—	—	—	Battersea.
—	—	—	—	—	—	—	—	—	—	—	Wandsworth.
—	—	—	—	—	3	—	—	—	3	—	Camberwell.
—	—	—	—	—	—	—	—	—	—	—	Greenwich.
—	—	—	—	—	—	—	—	—	—	—	Lewisham.
—	—	—	—	—	—	—	—	—	—	—	Woolwich.
—	—	—	—	—	—	—	—	—	—	—	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	Lee.
—	—	—	—	—	—	—	—	—	—	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).
§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

APPENDIX B.

No. 1.

On Modifications of the Cholera Vibrio artificially induced; by Dr. Klein, F.R.S.

App. B. No. 1.

On Modifications of the Cholera Vibrio, artificially induced; by Dr. Klein.

In my last year's report,* I have shown (pp. 121–35) that the typical cholera vibrio derived from an acute fatal case of Asiatic cholera, when cultivated in living oysters or in non-sterile sea water, may undergo definite modification both culturally and physiologically; and that the modifications thus induced remain permanent in subcultures carried on for many removes in ordinary culture media.

In this report I propose to discuss in detail the several varieties of the cholera vibrio referred to in my former report, along with additional three varieties obtained at a later stage of my investigations. For present purposes it will be convenient to take them in different order to that previously adopted, and I commence therefore with the variety that I propose to call vibrio V.

The several Vibrios of Experiment.

Vibro V.

This is the vibrio referred to at pp. 122–23 of my former report as recovered by peptone culture and gelatine plate from a flask of non-sterile sea water eleven days after inoculation of the water with an agar culture of the St. Petersburg cholera vibrio that had been for ten days incubated at 37° C. The modification thus effected persisted through several generations of subculture, as described on p. 122. For the sake of rendering clearer what I have to say in the following pages I will repeat what were those modifications.

(*a.*) The vibrio in question, vibrio V., was found to have lost altogether its power to grow at 37° C. either on agar or in peptone.

(*b.*) Vibrio V. grew, at 20° C., in peptone salt solution which became slightly turbid already in 24 hours, and it formed therein granules and flocculi. When tested with pure sulphuric acid after incubation for one, two, three, four, or more days, such peptone cultures gave no trace of cholera red reaction.

(*c.*) Vibrio V. from a recent peptone culture, examined in stained film specimens, appeared thicker than the St. Petersburg vibrio. In gelatine plates and in gelatine stab culture, and as regards fresh and flagella-stained specimens, it differed hardly at all from the St. Petersburg vibrio, except that in stab culture it formed a conspicuous coherent viscid pellicle already after a few days.

(*d.*) Vibrio V. when injected, even in considerable doses, into the peritoneal cavity of the guinea-pig, produced no diseased condition; the animal remained well. This is no doubt due to the fact that the vibrio not only does not grow but rapidly degenerates at the body temperature.

(*e.*) When tested with cholera serum, which brings about promptly the agglutinating reaction *in vitro* as regards the St. Petersburg vibrio, vibrio V. gave a negative result.

* Supplement to the report of the Medical Officer for 1894–95: "On Oyster Culture in Relation to Disease, 1896."

App. B. No. 1.

On Modifications of the Cholera Vibrio, artificially induced; by Dr. Klein.

This vibrio V. has now been transmitted for more than a whole year from culture to culture (gelatine stab, agar surface, and peptone culture); transference in the above sense having been effected about every fortnight, thus making more than 22 successive generations. Throughout it has retained unimpaired all the differential characters above described. It fails to grow at 37° C., it gives no cholera red reaction, and does not give positive result with cholera serum *in vitro*.

Be it remembered that this vibrio V. is unquestionably derived from the St. Petersburg cholera vibrio; the sea water in which the latter was incubated for 11 days contained previously no vibrio of any kind, as had been conclusively ascertained by numerous cultivations. This fact, even if it stood by itself, would, I think, go far to discount Pfeiffer's assertion that a vibrio which does not react to cholera serum cannot have been derived from cholera. Also the observation is in direct conflict with the views of many German observers, who maintain that certain vibrios isolated by them from various waters (Berlin, Massowa, Danube, &c.), and differing from the typical cholera vibrio in one or the other morphological and cultural character, cannot, because they so differ, have any relation to the cholera vibrio.

But this vibrio V. was not the only vibrio which became permanently modified by sojourn in non-sterile sea water. In my former report I described (*ibidem*, pp. 131 and 132) also a vibrio, vibrio IV., which was obtained in peptone culture from the non-sterile sea water of an artificial oyster tank, which tank water had been infected with a fully virulent cholera culture 13 days previously.

Vibrio IV.

This vibrio IV. was closely similar to vibrio V., inasmuch as it failed to grow at 37° C.; and further, like that variety, although growing well in peptone salt solution at 20° C., it failed to give the test of cholera red; it produced no disease when injected, even in large doses, into the peritoneal cavities of guinea-pigs. It grows much faster on the surface of agar at 20° C. than the St. Petersburg vibrio at 37° C.; it liquefies gelatine in plate and in stab culture much faster than the St. Petersburg vibrio; its colonies in the plate look quite different from those of the St. Petersburg vibrio; and in the stab culture there is already, after 48 hours at 20° C., at the top of the liquefied gelatine, a coherent thick white pellicle. Lastly, the vibrio IV. gives no reaction *in vitro* with cholera serum. Vibrio IV. has, like the other, been transmitted for more than a year through above 20 successive subcultures without showing any alteration in the above characters.

Studying side by side these two modifications, vibrios IV. and V., of the St. Petersburg cholera vibrio, the following are their chief differences. Vibrio IV. grows slower on the surface of agar (at 20° C.), and in a more transparent layer, than vibrio V. In gelatine stab culture, liquefaction is accelerated in both as compared with the St. Petersburg vibrio; but in the case of vibrio IV. the liquefied gelatine is more transparent than in that of vibrio V.; in the latter case, indeed, it is turbid. The pellicle, which is formed rapidly by both on the liquefied gelatine, is sticky and viscid in the case of vibrio V., more tenacious and white in vibrio IV. A further difference is this: vibrio IV. forms in peptone culture, already after 24 hours' incubation at 20 C., conspicuous spirilla, and in recent culture on agar, vibrio V. is more pronouncedly comma-shaped than

vibrio IV., which, under the same conditions, is very short, almost spherical.

While, then, vibrios IV. and V. are closely related as to the conditions under which they were obtained, as to their rapid growth in and liquefaction of the medium when grown in gelatine, as to their failure to grow at 37° C., as to their failure to give cholera red reaction in peptone culture (incubated at 20° C.), and as to their failure to react to the serum test *in vitro* and to grow in the animal body, they nevertheless are not identical, as is shown above by some morphological and some cultural differences.

Vibrio VI.

In my former report on the subject I have, p. 131, shown that from sea water of an oyster tank four days after infection with the St. Petersburg cholera culture, a vibrio was obtained which did not show any marked deviation from the parent. Morphologically, it is true, it appeared shorter and retained this character in all subcultures; but in all other characters—plate and stab in gelatine, agar surface, peptone culture, cholera red reaction, action in animal body—it was indistinguishable (except that it grew slower in the gelatine plate) from the St. Petersburg vibrio. Similarly when tested *in vitro* with cholera serum it did not differ from the recent St. Petersburg vibrio. I have in the above report described it (on p. 132) as vibrio V., but will hereafter refer to it as vibrio VI.

From the interior of oysters which had been kept in several cholera infected sea-water tanks, described in my report (l.c. pp. 123–31), three varieties of vibrios were obtained. In all instances recent cultures on agar of the typical St. Petersburg cholera vibrio had been used for infection of the water. The isolation of the vibrios from the interior of the oysters had been effected without difficulty by means of peptone cultures (l.c. p. 123).

The varieties thus obtained were—

Vibrio I.

This variety was obtained from the interior of an oyster that had been placed for four days in cholera infected sea water. It differed from the parent St. Petersburg vibrio: (*a*) by its slow growth in gelatine plates; (*b*) by its extremely retarded power of liquefying the gelatine in stab culture, the first indication of liquefaction at the upper end of the stab not taking place before five days; (*c*) by its less virulence on guinea-pigs when injected intraperitoneally—an amount of recent growth on the surface of agar twice that of a St. Petersburg culture being necessary to produce a fatal result. As regards growth on the surface of agar, cholera red reaction, morphological aspects, and as regards flagella staining, the vibrio did not differ from the parent St. Petersburg vibrio. Peptone salt culture of the microbe, after several days' incubation at 37°, showed a characteristic white continuous pellicle.

Vibrio II.

This vibrio was obtained from the interior of an oyster that had been kept in a tank of cholera infected sea water for nine days.* It differed

* l.c. p. 125.

App. B. No. 1.

On Modifications of the Cholera Vibrio, artificially induced; by Dr. Klein.

from the parent St. Petersburg cholera vibrio in the following respects:—(*a*) It did not grow at all in peptone salt solution, either at 37° C. or at 20° C.; (*b*) it did not grow, or grew only very feebly, on the surface of agar at 37° C.; (*c*) on the surface of agar incubated at 20° C., it grew as a slimy, very transparent, layer; (*d*) morphologically it appeared as commas, but principally as (-shaped and spiral-like forms, pointed at the ends and possessed of 1–3 flagella; (*e*) in gelatine plates it grew as liquefying circular areas with more or less concentrically arranged white masses; (*f*) in stab gelatine cultures the growth liquefied slowly and formed an extremely transparent funnel-shaped liquefied mass with a few grey flocculi; (*g*) intraperitoneal injection into the guinea-pig of 1–3 whole cultures produced no symptom of disease; (*h*) emulsion of the vibrio showed no agglutinating reaction with cholera serum.

Vibrio III.

This variety was, perhaps, the most interesting. It was obtained from the interior of an oyster that had been kept in a tank in cholera infected sea water for four days.* By means of peptone cultures the vibrio was easily isolated, and was found to differ from the parent St. Petersburg cholera vibrio in the following respects:—(*a*) It rapidly grew in gelatine plates, forming already, after 24–48 hours' incubation, liquefied round areas of turbid growth;† (*b*) in stab gelatine it liquefied as rapidly as the Finkler-Prior vibrio, the liquefied gelatine being uniformly turbid as in the case of the latter, but without odour; (*c*) on agar, at 37° C., or at 20° C., it formed a thick white opaque layer; (*d*) it grew well in peptone culture, forming strong turbidity, and already after 24 hours, spirilla of conspicuous length; (*d*) a peptone culture, incubated at 37° C. for several days, gave no cholera red reaction; (*e*) it acted more virulently in the peritoneum of guinea-pigs than the St. Petersburg vibrio; (*f*) in respect of size and shape (commas and (-shaped vibrios), and in respect of flagella, it did not differ from the St. Petersburg vibrio; (*g*) it gave practically no positive reaction with cholera serum, either *in vitro* or *in corpore*.

These three varieties, vibrios I., II., and III., were cultivated through more than a dozen successive removes without in the slightest degree showing any alteration in their principal characters. The only exception was that vibrio III., after many transferences from gelatine to gelatine (for more than 20 months), gave in peptone salt solution an indication of cholera red, but only after 5–6 days' growth therein at 37° C.

In all, there were, at the stage arrived at when I last reported, (1) the St. Petersburg vibrio—the typical cholera-vibrio of Koch; (2) vibrio I.; (3) vibrio II.; (4) vibrio III.; (5) vibrio IV.; (6) vibrio V.; and (7) vibrio VI. Every one of these had definite characters of its own, and each could, and still can, without difficulty be recognised and distinguished from every other. They therefore must be considered as permanent varieties, though having the same parentage, viz., the cholera vibrio of a cholera intestine. Of these different descendants of the St. Petersburg cholera vibrio, vibrio I. and vibrio VI. are, as already mentioned, more closely related to one another than the others;

* l.c. p. 128–130.

† p. 140, Plate V.

vibrio II. and vibrio III. differed strongly from the St. Petersburg parent, as also from one another; whereas vibrio IV. and V., although strongly resembling one another, differed in a marked degree from the St. Petersburg vibrio and from the others.

In all those varieties of vibrio which proved virulent on intraperitoneal injection of guinea-pigs (vibrio I., III., and VI.), the peritoneal exudation of the dead animal, which was full of vibrios, yielded on cultivation the same variety that has been used for injection.

I have now to add two further varieties—

Vibrios VII. and VIII.

Non-sterile sea water in two sterile flasks was infected in each instance with two or three platinum loopsfull of culture of Koch's vibrio scraped from the surface of agar. This culture had been incubated about a fortnight at 37° C. and, as plate cultures proved, yielded a pure crop of cholera colonies. After infection of the sea water in this way, the flasks containing it were well shaken and put by in a cupboard at the temperature of the room. Samples—0·1 to 0·5 c.c.—from the flasks were withdrawn from day to day and examined by peptone culture, from which, after 24 hours' incubation, gelatine plates were made. For seven days the peptone cultures thus made yielded cholera colonies which, when subjected to the various tests (morphological, cultural, and physiological), completely coincided with the parent St. Petersburg vibrio. But on the eighth day from one flask and on the ninth day from the other, peptone cultures were obtained from which subculture in gelatine plates yielded colonies that differed from the parent in regard to their behaviour towards cholera serum under Pfeiffer's test, *i.e.*, *in corpore*. But in no other sense did they differ. Examined side by side with the St. Petersburg vibrio as to morphology and flagella, as to plate cultures, as to gelatine stab cultures, as to the aspect and rapidity of the growth on the surface of agar at 20° C. and 37° C., as to their growth in peptone salt solution at 37° C., as to cholera red reaction, as to the effect of active peritoneal injection in the guinea-pig, and as to the agglutinating action of cholera serum on their emulsion, they differed in no way from the St. Petersburg cholera vibrio.

Reaction of the Eight Varieties of Vibrio to the Bordet-Durham and the Pfeiffer Tests.

In making comparison of these varieties of vibrio one with another, and of each with Koch's vibrio, I proceeded as follows :—

For the test *in vitro* as regards agglutinating action, as also for the germicidal test *in corpore*, recent agar surface cultures of the vibrios were used. The whole slanting surface of the agar (6 by 2 centimetres) was inoculated with the vibrio of experiment and incubated at 37° C. for 48 hours. If the particular variety was one that did not grow at 37° C. (as, for instance, vibrios II., IV., and V.), the agar culture was incubated at 20° C. for four days. Then the whole of the surface growth was scraped off and rubbed down in a definite quantity (5 c.c.) of sterile broth, and a uniform emulsion made by well shaking up the growth in the broth. A definite quantity (1 c.c.) of emulsion was used for each test, whether *in vitro* or *in corpore*, as will presently be described in detail.

App. B. No. 1.

On Modifications of the Cholera Vibrio, artificially induced; by Dr. Klein.

For test *in vitro* of the agglutinating reaction, one cubic centimetre of emulsion was placed in a small test tube furnished with a foot, and there was added a definite quantity of cholera serum, 0·10–·25 c.c., and the whole thoroughly mixed.

For test *in corpore*, a definite quantity of emulsion was injected into (*a*) a control guinea-pig, while (*b*) to a like quantity of emulsion a definite quantity of cholera serum was added and well mixed, and the mixture was injected into the peritoneal cavity of a second guinea-pig of about the same weight.

As to "cholera serum," three kinds were employed—

(1.) Blood serum obtained from a guinea-pig which had been immunised by intraperitoneal injection of living cholera culture* on three separate occasions between March 2nd and March 21st; the third injection naving been with one-fifth of a recent living agar culture of which one-eighth killed a guinea-pig in 20 hours. Eighteen days after the last injection this immunised animal, being then well and having gained in body weight, was killed and its blood was collected and allowed to coagulate so as to separate the serum.

(2.) "Cholera serum" kindly sent by Dr. R. Pfeiffer and obtained from a goat highly cholera-immunised.

(3.) Cholera serum kindly given me by Dr. Bulloch of the British Institute of Preventive Medicine, and obtained by him from a horse highly cholera-immunised.†

(A.) *Action* in vitro *of Cholera Serum in emulsion with one and another Variety of Vibrio.*

As already mentioned 1 c.c. of emulsion of definite strength was mixed in a small test tube (having a footstand) with 0·1 c.c. of serum. With a capillary pipette a few drops of the emulsion were then withdrawn, were put on an object-glass covered with a cover-glass,‡ and the specimen placed under the microscope and watched. When thus dealt with the commas and ( )-shaped forms are seen to be well isolated and briskly motile. Should the reaction of the serum be positive, it will be noticed that sooner or later—sometimes in less than a minute—the commas run together and become agglutinated into smaller or larger clumps, their movement having come to an end in the meantime. For a while a few isolated motile vibrios may still be observed between the clumps, but by-and-by all isolated motile vibrios join the clumps and become motionless. This agglutination or clumping is easily observed under the microscope, and is indeed confirmed by naked-eye inspection of the emulsion in the small test tubes. Herein, sooner or later, small granules make their appearance in the uniformly turbid fluid. At first

---

* l.c. p.133.

† Dr. Bulloch has from time to time given me samples of such horse's serum which acted in all respects very satisfactorily on the St. Petersburg cholera vibrio, both *in vitro* and *in corpore*; and, since plenty of it was placed at my disposal, I have been able to continue my experiments with the different vibrios on many subsequent occasions, the other two serums, viz., serum of my own guinea-pig and Pfeiffer's serum, having in the meantime been exhausted. To Dr. Bulloch I have therefore to return my very best thanks for a liberal supply of active cholera serum.

‡ A drop put on a cover-glass which is placed face downwards over a "hollow glass slide" is the best method, but that now in question also gives satisfactory results.

these granules are visible only under a glass, but by-and-by they become conspicuous to the unaided eye as larger and smaller flocculi gradually settling down and leaving the top layers of the fluid clear. This settling down of the clumps and clearing of the fluid is rapid and conspicuous in some cases of prompt reaction; in others it is not so conspicuous and is slow, occasionally taking several hours. In these cases of slow reaction, it may even happen that, although there appears a distinct and copious sediment of clumps, yet the top layers of the fluid remain slightly turbid and full of minute granules. In such cases microscopic examination shows that although there has occurred agglutination and arrest of movement, some of the clumps are small, and that these remain floating in the fluid, the large clumps alone having settled down as sediment.

Now, when to 1 c.c. of an emulsion of the scrapings of vibrio growth, obtained in the manner already described, 0·1 c.c. of any one of the above three kinds of cholera serum is added, the following differences will be noticed:—

(1.) *The St. Petersburg Cholera Vibrio.*—Clumping is very distinct under the microscope in five minutes; very few isolated motile commas. After 15 minutes, clumping complete under the microscope; on naked-eye inspection, distinct signs of clumping and settling down in the same time. After 30 minutes, clumping nearly complete to the naked eye, the clumps having almost quite settled down, leaving the fluid clear; only under a glass are there still some fine flocculi noticeable in it. In 45 minutes all clumps have settled and the whole fluid is clear.

(2.) *Vibrio I.*—Both to microscopic examination and to naked-eye inspection the serum reacts well with this variety, but somewhat slower than with the St. Petersburg vibrio. Thus, watching the mixture under the microscope, some aggregation and arrest of movement, although noticeable already in five minutes, is not so far advanced in 15 minutes as in the case of the St. Petersburg vibrio. In the case of vibrio I. there are still a few isolated motile vibrios noticeable, and the clumps are not so large as in the latter at this stage. Under naked-eye inspection also, some clumping is visible already after 15 minutes; after 30 minutes a surface layer of clear fluid is distinct, but, even after three-quarters of an hour, the settling down is far from advanced. After an hour and a half there is about a third to a half of the upper part of the fluid quite clear; the lower two thirds to a half are occupied by an opaque cloudy mass—the clumps; only after two hours has the greater part of the fluid become quite clear. While, then, vibrio I. gives positive result with cholera serum *in vitro*, its reaction to the serum is a little slower than is that of the St. Petersburg vibrio, using the same kind of emulsion and adding the same amount of cholera serum to the emulsion in both cases.

(3.) *Vibrios II., III., IV., and V.* give no reaction even if to 1 c.c. of emulsion 0·25 c.c. of cholera serum be added. Under the microscope there is observed no arrest of movement of the vibrios and no agglutination. On naked-eye inspection no sedimentation or clearing of the fluid is noticeable.

(4.) *Vibrios VI., VII., and VIII.* give positive reaction in nearly as pronounced a manner as the St. Petersburg cholera vibrio, 1 c.c. of emulsion and 0·1 c.c. of cholera serum being mixed together in each instance, but less quickly in point of time than the St. Petersburg vibrio.

App. B. No. 1.

On Modifications of the Cholera Vibrio, artificially induced; by Dr. Klein.

(B.)—*Reaction* in corpore *of Cholera Serum on one and another Variety of Vibrio.*

(1.) *St. Petersburg Cholera Vibrio.*—One-eighth to one-fifth of an agar culture, incubated for 48 hours at 37° C. and injected into the peritoneal cavity, kills a guinea-pig of 250 to 300 grammes weight with certainty in 20–24 hours. If to a similar amount of the same culture in emulsion, $\frac{1}{4}$ c.c. of the cholera serum (from either of the three sources) is added, and the mixture injected into the peritoneal cavity of a guinea-pig of the same weight, it will be found that the animal is seemingly well next day and that it remains alive.

(2.) *Vibrio I.*—Of this vibrio as much as $\frac{1}{4}$–$\frac{1}{3}$ of an agar culture incubated 48 hours at 37° C. is required to produce, on intraperitoneal injection, death of a guinea-pig of 250–300 grammes weight in 20–24 hours. If to a like quantity of growth in emulsion 0·25 c.c. of cholera serum be added, and the mixture injected into the peritoneal cavity of a guinea-pig of similar weight, the animal will be found to behave just like the control animal, that is, it is found next morning very ill, dying, or dead, as the case may be. If, however, as much as 0·5, c.c. of cholera serum were added the result was different with the three kinds of serum that I was using. With my own guinea-pig's cholera serum and with Pfeiffer's cholera serum there was no germicidal reaction — *i.e.*, the animal died; but with the horse's cholera serum there was positive reaction—the animal being found alive next morning.

There was an interesting fact observed in reference to some of the guinea-pigs that succumbed after intraperitoneal injection with vibrio I., viz., that the peritoneal exudation contained comparatively few vibrios, whereas the capillaries of the small intestine were injected and the gut itself filled with fluid which, in plate culture, yielded almost a pure culture of vibrio I. The vibrio thus cultivated from the intestinal contents was of exactly the same variety as that used for intraperitoneal injection.

(3.) *Vibrio III.*—This vibrio did not give positive result as regards germicidal action with cholera serum. I at first considered that cholera serum had germicidal action on this vibrio, having observed such action in one series of experiments; but I have not in subsequent and repeated series been able to confirm this observation. The animals that received the mixture of emulsion and 0·5 c.c. of cholera serum died just as soon as the control guinea-pigs that received emulsion only.

(4.) *Vibrios II., IV., and V.* could not be tested for the reasons already stated, viz., that these vibrios, when injected into the peritoneal cavity, even in large doses, produce no disease.

(5.) *Vibrios VI. and VII.* gave no reaction when 0·25 c.c. of either of the three kinds of serum was injected into the peritoneum of guinea-pigs along with an otherwise fatal dose of emulsion of the vibrio. So, too, with 0·5 c.c. of cholera serum of my own immunised guinea-pig or of that sent by Pfeiffer, the reaction was negative; but it was positive in this amount with the horse's cholera serum.

(6.) *Vibrio VIII.*—I have not been able to demonstrate germicidal reaction of any of the three sera in question on an otherwise fatal dose of this vibrio. The guinea-pigs that received the emulsion plus 0·5 c.c. of serum behaved (*i.e.*, died or were dying) just like the control guinea-pigs. I ought, however, to add that I have not made more than one series of experiments with this vibrio for each kind of serum. Another

point which I think necessary to mention here is, that in all cases in which an animal died after intraperitoneal injection of a mixture of vibrio and serum, the peritoneal exudation, when examined in fresh and stained cover-glass specimens, and by culture, was always found to abound with the particular variety of the vibrio that had been used for the injection.

From all these observations it follows that *physiologically* varieties Nos. I. and III. differ quite as widely from the parent St. Petersburg cholera vibrio as do the other vibrios *culturally.*

Test of the several Vibrios in Milk Culture.

Some further cultural differences between the different varieties of vibrio were found in their behaviour in skim milk and in (blue) litmus milk. Amongst the different varieties vibrio III. was the only one which produced separation of the coagulated from the fluid part of the milk, after incubation 10 days at 37° C. The coagulation does not, however, with vibrio III., take place in the usual manner, viz., solidification of the milk as a whole with subsequent separation of curds and whey; but the milk is so altered by vibrio III. that a top layer of turbid fluid becomes differentiated from the rest, which is thick and forms a yellowish coagulum. In the case of vibrios II., IV., and V. the milk cultures were of course kept at 20° C., but they showed no separation or coagulation at any time. On the other hand, of the milk cultures made with the St. Petersburg cholera vibrio, and with vibrios I., VI., VII., and VIII., and incubated at 37° C., the following results were obtained: Coagulation took place in the typical manner in one month in the cases of the St. Petersburg vibrio, vibrio VI. and vibrio VIII.; whereas the milk cultures made with vibrios I. and VII. remained fluid. Blue litmus milk inoculated with the St. Petersburg vibrio and with vibrios I., VI., VII., and VIII., and incubated at 37° C., became neutral in seven days and did not change on further incubation; so that these vibrios produced acid only very faintly. Vibrio III. incubated at 37° C., and vibrios II., IV., and V. incubated at 20° C., did not alter the blue colour of the litmus milk. In the case of vibrio III., which caused separation of the normal milk as mentioned above, no alteration in the colour of the litmus milk was produced after separation had set in.

As to the Possible Influence of Microbes normally present in Sea Water in modifying Koch's Cholera Vibrio.

It occurred to me, in view of the several varieties of vibrio obtained directly from non-sterile sea water previously infected with culture of the St. Petersburg cholera vibrio, or from the interior of oysters that had been kept in such infected sea water, to seek to ascertain whether or not some of the microbes present in the sea water had any influence on the St. Petersburg cholera vibrio if they are kept living together, *i.e.*, symbiotically in ordinary artificial culture media. The following experiments were made to test this:—

From the non-sterile sea water which had been used in the above experiments a microbe was isolated by means of agar plates which, in morphological and cultural respects, could be readily identified, and which I propose to call *leptothrix luteus.* It appears essentially as thin, long,

uniform threads, some of great length, some shorter. These threads form conglomerations, so that when making film specimens it is not easy to untwist them. The colonies of the micro-organism are round, slightly prominent, moist looking, and of a distinctly yellow—golden-yellow to orange-yellow—colour. The leptothrix grows best at 20° C., it grows also at 37° C. (on agar, less freely in peptone), but very slowly. In gelatine it forms a yellow growth which only very slowly liquefies the medium.

Sterile normal peptone salt solution was infected with particles of a recent culture on agar of this leptothrix luteus, and at the same time with a particle of a recent culture on agar of the St. Petersburg vibrio. It was then incubated at 37° C. Subsequently, and until the tenth day of incubation, surface agar plates were made from day to day with material from this peptone culture, and were incubated for 24 hours at 37° C. Of the colonies of vibrios appearing on these agar plates, some were examined at once under the microscope, others were used for sub-cultures in gelatine plates, on agar surface, and in gelatine stab cultures; but the resulting microbe could in no instance be distinguished from the typical St. Petersburg cholera vibrio. Beginning with the twelfth day, however, a change was noticed in an agar plate made from a peptone culture that had been simultaneously infected with leptothrix luteus and with the St. Petersburg vibrio. The change in question consisted in this:—The film specimens made from the vibrio colonies—24 hours on agar at 37° C.—did not present the typical appearances of well-curved commas and ( ) -shaped forms. They showed mainly filaments, long and short, wavy or more or less twisted, amongst which only a few slightly curved commas and ( ) -forms were observed. Subcultures were made in agar streak, in gelatine stab, in peptone solution, and in gelatine plates, and the characters of the vibrio were thus further investigated. But whether from gelatine plates, from gelatine streak, or from agar surface, the microscopic specimens, fresh and living, and the stained films, which were submitted to examination, invariably showed the conspicuous feature of longer or shorter twisted and wavy filaments; some isolated, but more commonly in clumps. Making an agar surface streak or plate culture of the parent St. Petersburg vibrio, and at the same time a similar culture of this filamentous vibrio, and incubating the test tubes at 37° C. for 24 or 48 hours, the resulting colonies were found indistinguishable in aspect and rapidity of growth. But on making microscopic examination the differences were striking. A particle of the growth of the St. Petersburg vibrio culture easily broke up in a drop of saline solution or of broth into an uniform emulsion of commas and ( ) -forms. Whereas the other, viz., the filamentous vibrio, did not easily break up or easily make an uniform emulsion; there remained always in the fluid many granules, which under the microscope were seen to be conglomerations of vibrio threads.

I propose, therefore, to consider this vibrio as variety IX., and to call it *vibrio filamentosus*. Through however many generations in sub-culture or in the peritoneal cavity of the guinea-pig this vibrio is passed —and there have been a great many such generations—it always retains conspicuously the characters for which I have named it vibrio filamentosus, though, as already stated, there are always present besides filamentous forms, isolated or conglomerated, short and long comma and ( ) -shaped vibrios. This vibrio filamentosus, or vibrio IX., grows

in gelatine plate and in gelatine stab like the St. Petersburg cholera vibrio. With it, liquefaction, in stab culture, is a little retarded, but under both conditions of its culture the liquefied gelatine contains white granules more conspicuously than in the case of the St. Petersburg vibrio. On agar surface vibrio IX. forms the same translucent flat, round, moist-looking colonies as does the St. Petersburg vibrio; but they become soon less transparent and distinctly more granular. In peptone salt solution, incubated at 37° C., vibrio filamentosus forms granules and flocculi-conglomerations of threads. Such peptone salt culture gives pronounced cholera red reaction already after 24 hours' incubation; but this takes place, if anything, a little later than in peptone salt culture of the St. Petersburg cholera vibrio. That is to say, the cholera red tint after addition of sulphuric acid is, in the peptone salt culture of the vibrio filamentosus incubated for 36 hours at 37° C., not so pronounced and deep as in a similar culture of the St. Petersburg vibrio; in fact not more pronounced than in peptone culture of the St. Petersburg vibrio after incubation for only 24 hours at 37° C. As regards its motility and flagella (one to three) it does not differ from the St. Petersburg vibrio.

There exists a further difference between the two vibrios in that the vibrio filamentosus is much less virulent than the St. Petersburg vibrio when injected into the peritoneal cavity of a guinea-pig. To produce a fatal result in 24 hours in a guinea-pig weighing 300 grammes half of an agar culture of vibrio filamentosus is required. The peritoneal exudation contains the vibrio in abundance, and the microbe recovered therefrom retains morphologically and culturally all the characters of the vibrio filamentosus. Milk inoculated with vibrio filamentosus remains fluid.

As mentioned already, I have passed this vibrio through a very considerable number of subcultures, as well as through guinea-pigs, and it has retained its characters unaltered. This vibrio was subjected also to the serum test, and was found to give well the agglutinating reaction *in vitro* (both in the test tube and under the microscope) in the proportion of 1 c.c. of emulsion of the vibrio to 0·1 c.c. cholera serum. But agglutination and separation takes place a little slower than with the St. Petersburg vibrio when similarly tested. The reaction *in corpore* of vibrio filamentosus failed with all three kinds of serum, using 0·5 c.c. serum for a fatal dose.

We have, then, here a variety of vibrio which has been derived unmistakably from the typical St. Petersburg cholera vibrio, and *which is possessed permanently of differential characters* by which it can be easily distinguished from its parent, although it possesses also some characters which indicate its parentage. The morphological, cultural, and physiological characters in which this vibrio filamentosus differs from the St. Petersburg cholera vibrio are certainly not less pronounced than those distinguishing a number of other vibrios (Massowa vibrio, and certain water vibrios), vibrios which, owing to differences of like kind, in one or another respect, have been denied any relation to the cholera vibrio. I think this vibrio filamentosus alone proves how unjustifiable such a denial is. The above morphological and cultural characters are not mere incidental or casual differences, such as are well known to occur in the laboratory with the cholera vibrio, but are differences which remain the same from the outset. Any-one seeing, for instance, the stained film specimens of the vibrio filamentosus made from an agar surface 24 hours old, and comparing them with film specimens of the parent St. Petersburg vibrio made

under exactly the same conditions, cannot but be struck by the remarkable difference. The film specimen of the latter is at once and easily recognised as a specimen of cholera commas, whereas a film specimen of the former is utterly different (Plate I., Figs. 1 and 2), and can hardly be believed to be a microbe derived from the cholera vibrio. Nevertheless if both are tested side by side in gelatine plates, in gelatine stabs, in agar plates, in peptone salt solution (for cholera red reaction), and are tested also with cholera serum *in vitro*, their relationship is clear and striking.

While the facility with which this vibrio filamentosus was produced, viz., by culture for 11 days in peptone salt solution in association with leptothrix, luteus is highly interesting, the persistency with which the once altered vibrio retained its differential characters is even more remarkable. This fact may have important significance in respect to the cholera vibrio that, although derived undoubtedly from a cholera intestine, has sojourned for some time and for many generations in unusual and unaccustomed surroundings. I recall here an observation which is very much to the point in this connexion. At the end of August 1893, Asiatic cholera appeared in Hull, and almost the first case was that of a boy who, with other boys, had bathed and dived in a canal (Sutton Dyke) the water of which was polluted by sewage. Dr. Theodore Thomson, who investigated this outbreak, was disposed to believe, in view of all the circumstances, that this boy had received infection through having swallowed some of the dyke water while diving. Other boys, be it noted, who had apparently done the same became affected with sickness and diarrhœa; this boy alone had a virulent and rapidly fatal attack of Asiatic cholera. His intestine and its contents, which were submitted to me, were typical of cholera. The comma-bacillus that I isolated therefrom was in its distribution, in numbers, in size, in shape, and in cultural and biological characters, none other than Koch's cholera vibrio. Now, the water from the above dyke was also carefully examined by me, and, as described in the report of the Medical Officer on Cholera in England in 1893, one kind only of vibrio was abundantly isolated from it. This vibrio was found to differ markedly in cultural respects from the typical cholera vibrio isolated from the boy's intestine. In plate gelatine cultures it was markedly different from the cholera vibrio; in gelatine stab it grew as fast, liquefied as fast, and made the liquefied gelatine as turbid as the vibrio of Finkler-Prior, though it differed from that microbe in the absence from its cultures of any malodorous smell, and by its peptone salt cultures growing well at 37° C. and giving good cholera red reaction. Also it proved virulent when injected into the peritoneal cavity of the guinea-pig. At that time, owing to the strikingly different behaviour of this Hull water vibrio in gelatine plates and gelatine stab culture, I came to the conclusion that this vibrio was not Koch's cholera vibrio, though Dr. Thomson maintained that, nevertheless, it must have been related to that vibrio. From the knowledge now gained of the profound variation of which Koch's cholera vibrio is capable under laboratory conditions, I think Dr. Thomson's view may after all have been the correct one. Of course there still remains the difficulty of explaining how the Hull water vibrio at once resumed, in the intestine of the boy, its pristine condition as the typical cholera vibrio; but considering that the human body is an extremely complex association of conditions which we cannot expect to see repeated in the laboratory test tube or in the guinea-pig, the difficulty may be, and probably is, only a relative one. That the Hull water vibrio had permanently acquired characters by which it

differed from the original cholera vibrio is, however, a fact which might be explained in the light of the above experiments, viz., by its having been for some time and generations subjected to abnormal, more or less unfavourable, surroundings.

The same argument would seem applicable to the vibrio found by Pestana in the intestinal discharges of persons attacked by "epidemic cholerine," in Lisbon, during 1894. This vibrio, which through the kindness of Dr. Pestana I had an opportunity of examining, differed—as Dr. Pestana has fully described in the Centralblatt für Bakteriologie—from Koch's cholera vibrio in that it grew much more slowly in all media, liquefying gelatine much more slowly, and not responding to Pfeiffer's test *in corpore.* Also it was much less virulent than the cholera vibrio, and in peptone culture gave no cholera red reaction with pure sulphuric acid. Dr. Pestana found the same vibrio in Lisbon water. This Lisbon vibrio is, I think, very probably a modified cholera vibrio, which, introduced into that country, during the preceding year or years, and living under abnormal conditions, had not only changed its cultural but also its physiological characters; the latter being indicated by the fact that it acted markedly less virulently on the guinea-pig, and produced in human beings only a mild form of cholera.

Lastly, Sanarelli (Annales de l'Institut Pasteur, 1894) isolated from the water of the Seine and from that of several of its tributaries a number of vibrios which, in cultural respects and as regards cholera red reaction and their effect on intraperitoneal injection into the guinea-pig, differed not only more or less from one another but also from Koch's cholera vibrio. Sanarelli maintains that these different vibrios, being derived from waters to which, in the preceding year, cholera discharges had had access, were, in all probability, varieties of one and the same parent, viz., the cholera vibrio, but that having lived under exceptional circumstances, viz., in the river waters, they had acquired permanently new characters. Pfeiffer, however, denies the correctness of this conclusion, since Sanarelli's water vibrios do not respond to his (Pfeiffer's) test *in corpore.* From what I have already shown by direct experimental evidence, Sanarelli's conclusion is, I think, correct; at any rate, the derivation of his water vibrios from Koch's cholera vibrio cannot be set aside on the ground stated by Pfeiffer, viz., that they differ culturally and physiologically from the microbe of true cholera.

Experimental Attempt to restore to the several Varieties of Vibrio the Characters of their St. Petersburg Parent.

Having given the characters of a number of stable varieties of the cholera vibrio, I come now to experiments which were undertaken with a view to reconverting them in each instance into a vibrio identical in some or all characters with their parent St. Petersburg cholera vibrio. And here I may as well state at once that, although the various conditions of cultivation which I contrived to this end have been subjected to a number of modifications, I must needs confess that hitherto I have failed in my endeavour. That is to say, I have failed to produce in any one variety alteration sufficient to make it identical with the St. Petersburg cholera vibrio. They all retained most of their characters with an astounding tenacity; so much so, that if I had been dealing solely with vibrio II. and vibrio III. (the two varieties derived from oysters kept in cholera-infected sea water, and which have been shown to be totally unlike the cholera vibrio in almost every character), I should certainly have become doubtful whether these two vibrios had had any past connexion with the St. Petersburg vibrio.

App. B. No. 1.

On Modifications of the Cholera Vibrio, artificially induced; by Dr. Klein.

As to vibrio No. I., also derived from the interior of an oyster kept in cholera infected sea water, its retention of the characters distinguishing it appeared of less moment, since it differed little at any time from the St. Petersburg vibrio in its biological and physiological characters. Nevertheless, the fact that it did persistently retain its characters, viz., very slow liquefaction of gelatine, slow growth in plate culture, different aspect of its colonies in gelatine plates from those of the typical cholera vibrio, and its lesser virulence on the guinea-pig, was not without importance, as indicating it to be a fully-established variety. With still greater force can this be said of vibrios IV., V., VI., and IX., as to which there can be no doubt at all that they were derived from the St. Petersburg cholera vibrio; meanwhile, the numerous and varied alterations in the culture media to which they were subjected had no material effect on bringing back to them the characters of their parent.

All this serves to emphasise the fact that, in the case of the St. Petersburg cholera vibrio, a permanent alteration of characters is comparatively easily achieved, and the fact also that these alterations, once acquired, are retained with such persistency that practically new species are the result.

This, it is known, and has been pointed out in the Oyster Report of the Medical Officer, 1896, *does not* apply to the typhoid bacillus; a microbe which is more hardy, and in which, as a large number of experiments that I have made with it and with the bacillus coli prove, it is extremely difficult to bring about, by alteration of the culture media, any material modification of morphological, cultural, or physiological characters, except, perhaps, a more or less pronounced decrease of virulence in the peritoneum of the guinea-pig.

I think it important here to re-state that, in speaking of modification, I refer to *permanent* modifications—an alteration which remains when the microbe is cultivated again in the original or suitable medium. One cannot with justice speak of modification in character if a microbe, owing to alteration of medium, temperature, animal, &c., differs only for the time being from its parent, but regains its pristine characters when again cultivated through one or two generations in the medium normal and suitable to it, as, for instance, the streptococcus erysipelas, the pneumococcus, bacillus prodigiosus, and a number of other microbes. Now, with reference to the several varieties of cholera vibrio that are in question this does *not* apply. By no artificial laboratory conditions—comparatively limited, of course, as compared with the innumerable unknown variety of conditions that may take place in nature, and which cannot be repeated in the laboratory—have I been able to bring them back to a resemblance of the St. Petersburg vibrio. As will be pointed out presently, one or the other of these varieties has been modified somewhat in one or another character, though in nothing that made them materially dissimilar to what they were before. When growing them again under the pristine conditions of suitable medium, they returned at once to their pristine characters by which they originally were distinguished, as varieties of the St. Petersburg vibrio.

My proceedings in attempting to restore to these vibrios the characters of the St. Petersburg microbe have been as follows:—

Series I.—Culture of the modified Vibrios in association with Bacillus Coli.

In the following series of experiments the most markedly diverse of the above varieties of cholera vibrio were employed to ascertain whether,

and, if so, to what extent, an alteration takes place in their characters when they are grown in association with a bacterium which is a normal inhabitant of the alimentary canal, *i.e.*, the bacillus coli communis; and to ascertain also whether thereby any of these varieties can be brought back to the characters of their parent St. Petersburg vibrio. Such a condition of symbyosis with bacillus coli would seem to be the very condition under which the vibrios would be placed if introduced into the alimentary canal of the human subject.

Accordingly separate samples of sterile peptone salt solution were simultaneously infected with—

(*a.*) A recent agar culture of the typical bacillus coli; plus

(*b.*) A recent agar culture of either:—(1.) St. Petersburg cholera vibrio; (2.) Vibrio I; (3.) Vibrio III; (4.) Vibrio V; or (5.) Vibrio IX.

These several vibrios are so pronounced in their differential characters that any alteration in them could be readily recognised. The St. Petersburg vibrio being the typical cholera vibrio; vibrio I. would be readily recognised by its slow growth and slow liquefaction in gelatine plate and gelatine stab culture; vibrio III. would be readily recognised by its extremely rapid growth and liquefaction in gelatine plate and gelatine stab, and by its failure to give cholera red reaction; vibrio V. would be readily recognised by its rapid growth in gelatine and by its failure to grow at 37° C.; and vibrio IX. would be readily recognised by its markedly filamentous growth in all media.

After inoculation of the peptone salt solution with bacillus coli and with one or other of the above vibrios, the test tubes were placed in the incubator at 37° C., except, of course, those inoculated with bacillus coli and vibrio V., which, since this latter vibrio does not grow at 37° C., were incubated at 20° C. These peptone cultures having been kept in the incubator for 5, 10, 15, and 21 days (those of bacillus coli and vibrio V. for 10, 15, 21, and 27 days), subcultures were made at corresponding intervals in each instance. In those instances in which the peptone culture had been incubated at 37° C., *agar* surface plates were made by spreading, by means of a sterile bent platinum spatula, a droplet of peptone culture over the whole surface of the medium previously set in a thin layer in a plate dish, and then incubating the subculture at 37° C. In 24 to 48 hours a distinction between the colonies of the colon bacillus and the vibrio of experiment is easily noticed; the colonies of the former being large, white, and opaque, those of the latter, smaller, thinner, and translucent. In the case of the peptone cultures incubated at 20° C. (colon and vibrio V.) *gelatine* surface plates were made and incubated at 20° C. Here again, after a lapse of 48 hours, the colonies of the colon bacillus are easily picked out from amongst those of the vibrio; the former being non-liquefying, grey, white, flat colonies, with filmy irregular margin, the latter being round and liquefying. From the colonies of vibrios that appeared in these *first* plates (agar or gelatine respectively) subcultures were made in gelatine stab, gelatine surface plates, in peptone, and on the surface of agar in tubes, and their characters studied more minutely; the peptone cultures being used for cholera red reaction, the agar surface cultures for serum test or for intraperitoneal injections into guinea-pigs.

The result may be summed up in a few words. In no single instance was any marked alteration of the above vibrios observed either in morphological, cultural, or physiological respects when they were grown in association with bacillus coli in peptone salt solution. Even after 21 days' growth of the several varieties in association therewith,

App. B. No. 1.

On Modifications of the Cholera Vibrio, artificially induced; by Dr. Klein.

subcultures of the vibrios established in the fashion I have noted showed, in each instance, all the normal characters of the microbe; they could easily be identified by their differential characters. The only tendency toward exception was exhibited by the St. Petersburg vibrio and by vibrio III. These, when gelatine stab subcultures were made from the agar plates established from original peptone tube after 21 days' incubation, appeared somewhat tardy in exercise of their power of liquefying the gelatine; but on making further subcultures from each such gelatine stab, the original rate of liquefaction was, in each instance, re-established and maintained in further subcultures. For the rest, vibrio I. retained unaltered its slow growth and liquefaction of gelatine in plate and stab culture. Vibrio III. also remained unaltered in the further subcultures; it grew fast on and rapidly liquefied gelatine, and still gave no cholera red reaction and no positive reaction with cholera serum *in vitro*. Vibrio V. (after 27 days' symbyosis at 20° C.) still failed to grow at 37° C., and failed to give either cholera red reaction or serum reaction *in vitro*. Vibrio IX. still retained its pronounced filamentous character and its decreased virulence. The St. Petersburg vibrio, vibrio I., and vibrio IX., gave good cholera red reaction and good cholera serum reaction.

There was, therefore, not much encouragement to proceed further with these experiments; the less since it was observed that by this time, 21 days and 27 days respectively, extensive degenerations of the vibrios in the peptone cultures had set in, so that in the agar surface plates and gelatine surface plates respectively made from these peptone cultures comparatively few colonies of vibrios were now obtainable.

Series II.—Culture of the Vibrios in Sewage.

Normal sewage, such as flows out from St. Bartholomew's Hospital, was strained and sterilised by boiling, and to it was added pure peptone to the amount of 1 per cent. This material, in several separate test tubes was inoculated with the following vibrios, all of them taken from recent active agar cultures:—(1) the St. Petersburg cholera vibrio; (2) vibrio I.; (3) vibrio II.; (4) vibrio III.; (5) vibrio IV.; (6) vibrio V.; and (7) vibrio IX. The cultures of vibrio II., IV., and V. were incubated as a matter of course at 20° C., those of the rest at 37° C.

On inspecting the cultures after four days, it was found that culture (1) (St. Petersburg vibrio), culture (2) (vibrio I.), and culture (7) (vibrio IX.) showed good growth and were turbid; whereas none of the others showed any growth, the fluid being still quite clear. The same result was noticed after further three days. The culture of the St. Petersburg vibrio showed good and uniform turbidity with an attempt of formation of a pellicle; the culture of vibrio I. was uniformly turbid with a characteristic white pellicle, in fact, with a scum as in normal peptone salt culture; and the culture of vibrio IX., though only slightly turbid, contained numerous granules and flocculi, and, therefore, did not differ from a normal peptone salt culture. At the same date cultures in the sewage of vibrios II., III., IV., and V. showed no trace of growth.

From this it follows that by cultivating the several vibrios in sewage and peptone, the vibrios not capable of growing at 37° C. (II., IV., and V.), and also vibrio III., could be separated from the St. Petersburg vibrio, vibrio I., and vibrio IX. These three alone being able to thrive in apparently normal fashion in the above culture fluid.

Examining these sewage peptone cultures, first by agar surface plates and then by subculture therefrom in gelatine plates, gelatine stab, and

agar surface; by test in peptone salt solution for cholera red reaction; and by test of their serum reaction and their virulence in the peritoneal cavity of the guinea-pig; as also with respect to their morphological characters as seen in fresh and stained flim specimens, no differences could be found indicating that these three vibrios had by their growth in sewage-peptone undergone any alteration whatever. The differences between St. Petersburg vibrio, vibrio I., and vibrio IX., described above, remained as pronounced as ever; the characters by which these three vibrios differed from one another remained absolutely the same. Whether the sewage-peptone cultures of these three vibrios, *i.e.*, those in which alone growth had taken place, were examined at the end of four days, of seven days, of 14 days, or of 25 days, the result did not differ. After 25 days, extensive degeneration had set in in the cultures, as indicated by the comparatively few colonies that appeared in the agar plates, and further examination of them was, therefore, discontinued.

Sterile sewage with peptone can, therefore, serve as a good culture medium for the three varieties in question without interfering with their morphological, cultural, and biological characters.

Series III.—Culture of the Vibrios in Nitrite Peptone.

As a culture medium in this series there was used peptone salt solution containing 2 per cent. peptone, 2 per cent. sodium chloride, and 1 per cent. potassium nitrite. The mixture was decanted into test tubes and sterilised by repeated steaming in the ordinary way. Cultures were then made in this nitrite peptone with the several varieties of vibrio, the inoculation being in all cases made from recent agar and gelatine cultures. As in the previous series, vibrios II., IV., and V. were incubated at 20° C., the others at 37° C.

On inspection, after four days' incubation, it was found that only vibrios IV. and V. showed growth. The culture fluid containing vibrio V. was covered with a well-pronounced pellicle, which on microscopic examination and on subculture in gelatine (plate and stab) proved identical with vibrio used. The culture fluid containing vibrio IV. had just a trace of a pellicle, which also, when tested by microscopic examination and subculture, yielded the vibrio of experiment.

On inspection, after seven days' incubation, there was seemingly an indication of growth in the culture of the St. Petersburg vibrio, and in those of vibrios I., III., VI., VII., VIII., and IX.; the culture fluid being in each instance just slightly turbid. Vibrio II. showed at this time no trace of growth.

The cultures were again inspected after a fortnight's incubation, when it was found that only the peptone nitrite culture of vibrio III. had marked turbidity; the culture of vibrio I. had slight turbidity; the St. Petersburg vibrio and vibrios VI., VII., VIII., and IX. cultures had made no progress; vibrio II. culture was sterile; and those of vibrios IV. and V. exhibited thick pellicle. The nitrite peptone cultures of the St. Petersburg vibrio and vibrios VI., VII., VIII., and IX. were now tested in gelatine stab culture, but all failed to yield any growth; they were therefore discarded from further observation.

Similar subcultures were made of the original nitrite peptone cultures of vibrios I., III., IV., and V., after incubation for 14 days, in order to see whether any change had by this time occurred in the vibrios as a result of their sojourn and growth in this fluid, and the process was repeated after incubation for 23 days.

App. B. No. 1.

On Modifications of the Cholera Vibrio, artificially induced; by Dr. Klein.

As a result it was observed that the difference in the rate of growth in stab gelatine culture, in the greater or lesser turbidity of the liquefied gelatine, and in the nature of the pellicle—differences mentioned in a former series as distinguishing between vibrios IV. and V.—became more accentuated after these vibrios had been growing in nitrite peptone for 14 days. But they still refused to grow at 37° C., even after 23 days in the nitrite peptone solution; nor had they acquired the power to give indol reaction in an ordinary peptone salt subculture; nor did emulsion of an agar surface growth of them react positively to the cholera serum test. Vibrio I. remained quite unaltered from the original stock even when the nitrite peptone culture had been incubated for 23 days at 37° C. Vibrio III. showed already, after seven days' incubation 37° C. in nitrite peptone, a somewhat more pronounced rapid liquefaction in gelatine plate and in gelatine stab, the liquefied gelatine being uniformly turbid; but in this respect it did not alter after 14 or 23 days' incubation respectively. This vibrio, it will be remembered, showed originally a marked tendency to grow rapidly in shorter or longer spirals in peptone salt solution, less so on agar. It was now found, after incubation for seven days in nitrite peptone, to exhibit in agar surface subculture, after 24 hours' incubation, a growth almost entirely made up of rapidly motile spirilla, some of extreme length. Such a culture is, indeed, a very useful material for showing fine, well-twisted, spirilla, and in this respect vibrio III. differs markedly from all the others. As regards behaviour in milk, a notable change was found to have taken place by the cultivation of vibrio V. in nitrite peptone for 23 days. Originally this vibrio, growing in milk at 20° C., did not alter the milk; but it now, on inoculation into that medium, after 23 days' growth in nitrite peptone, produced rapid decomposition of the milk, with thick scum on the surface. As regards its inability to give the cholera red reaction and to respond positively to the serum test, vibrio III., grown for 23 days in nitrite peptone, did not show any alteration whatever.

Series IV.—Culture of the Vibrios in "Oyster Gelatine."

In this series a material was used as nutritive medium which has the composition of nutrient broth gelatine, but with the difference that a broth made from oysters was substituted for beef broth. Fresh oysters—such as are bought in the market as fresh—were opened, the liquor and the oysters themselves collected in a beaker, and distilled water to the amount of one pint for each three-quarters of a pound of oysters added. The mixture was then boiled for ½ to 1 hour. To this, pure gelatine was then added to the amount of 10 per cent., and pure peptone and sodium chloride each to the amount of 1 per cent. This "oyster gelatine" was then treated for alkalisation, was filtered and decanted into test tubes, and was subjected to repeated sterilisation in the steamer, just like normal alkaline beef-broth gelatine. It proved to be an excellent solid medium for the growth of all the vibrios.

With the above 10 varieties of vibrio, stab cultures were in each instance made in oyster gelatine from a stock culture of the microbe in normal gelatine; and from these *first* subcultures in oyster gelatine further subcultures in the same medium were made and carried on for a considerable number of generations. In all cases the new subculture in oyster gelatine was made, or new generation started, from the preceding generation in oyster gelatine after this latter had well advanced

in growth; this was generally the case after six or seven days' growth at 20° C.

Commencing with the fifth remove, each generation was used for comparing the vibrios in their morphological, cultural, and physiological characters with those of the stock cultures. The enormous amount of work which this part of the inquiry entailed will be understood from the fact that the St. Petersburg vibrio, and vibrios I., II., IV., V., VI., VII., VIII., and IX. were carried through 18, and vibrio III. through no less than 27 successive generations in oyster gelatine.

The principal facts noted as indicating tendency perhaps towards a permanent alteration of one or another character of the vibrios by their repeated culture in oyster gelatine are the following:—

1. *Liquefaction of Gelatine.*—One of the first and most interesting of the results observed, was that, after about 10 or 12 transmissions through oyster gelatine, all the vibrios, except I., II., and III., suffered a decided diminution in their power to quickly liquefy ordinary nutrient gelatine. This retardation in liquefying power was as pronounced, both in gelatine plates and in gelatine stab, after the twelfth generation as after the eighteenth, and it was retained through several subcultures in ordinary gelatine.

Vibrio I. it will be remembered was, as compared with the St. Petersburg cholera vibrio, originally very tardy in liquefying gelatine; and this character it retained when carried through a large number (17) of successive generations in oyster gelatine. If a comparison be made between the St. Petersburg vibrio of a stock culture and the vibrio I. also of a stock culture, the former is conspicuously more rapidly liquefying than the latter. But if, on the other hand, comparison be made between the St. Petersburg vibrio from one of its later generations in oyster gelatine and vibrio I. from a similar remove in oyster gelatine, the result is altogether different; for by the successive subcultures of the St. Petersburg vibrio in oyster gelatine, its ability to liquefy ordinary gelatine has become so far retarded that in this respect not much difference is observable between it and the vibrio I. Vibrios II. and III. remain as before rapid liquefiers of gelatine through however many generations in oyster gelatine they are transmitted.

Now, it will be remembered that vibrios I., II., and III. are the very vibrios which had been obtained in the first instance from the interior of oysters which had been kept in cholera infected sea water; wherefore, the fact that all other vibrios not derived from oysters suffered modification of liquefying power in oyster gelatine may be due to the circumstance that they had not been previously accustomed to an oyster medium.

2. *Morphologcial change.*—As regards morphological changes, the only one observed concerned vibrio IX., after it had been transmitted through many successive cultures in oyster gelatine. While vibrio IX. retains the filamentous nature of its elements unimpaired in normal gelatine, through however many subcultures it be passed, in oyster gelatine it gradually loses it. Thus, after the twelfth generation in oyster gelatine, the elements of vibrio IX. were found to be oval, short rods, or commas, and but few filaments, whereas the original stock retains always in ordinary gelatine its pronounced filamentous character.

3. *Cholera-red Reaction.*—As has been already mentioned, vibrio III. grows well in peptone salt solution at 37° C.; nevertheless when such a culture is tested after 48 hours' incubation with sulphuric acid, no

APP. B. No. 1.

On modifications of the Cholera Vibrio, artificially induced; by Dr. Klein.

nitroso-indol (cholera red) reaction is demonstrable. Only after many transmissions (for over 20 months) in ordinary nutrient gelatine did this vibrio when again transferred to peptone salt culture, give, after incubation for 5–6 days at 37°, the characteristic rose-tint with sulphuric acid; and even then the tint was by no means so deep as in a typical cholera peptone culture after 48 hours' incubation at 37° C. But on transmitting vibrio III. through successive subcultures in oyster gelatine it was noticed, beginning with the fifteenth to the sixteenth generation, that a distinct cholera red reaction was obtainable in the peptone cultures therefrom already after 48 hours' incubation; and that by the twenty-fifth generation the cholera-red reaction of a peptone culture, incubated for 48 hours at 37° C., was as pronounced and deep as that of similar peptone culture of the typical St. Petersburg cholera vibrio. Vibrio IX., on the other hand, having been passed through a number of successive cultures in oyster gelatine, showed a slight diminution in cholera-red reaction as compared with vibrio IX. from a stock culture in ordinary gelatine tested under precisely the same conditions. The difference is in the amount of nitroso-indol reaction as judged by the depth of pink colour.

4. *Behaviour to Bordet-Durham Test.*—It will be remembered that vibrios I., VI., VII., VIII., and IX. gave the agglutinating reaction with cholera serum in a pronounced manner both under the microscope and to the unaided eye. In this sense they differed from the St. Petersburg vibrio solely in the circumstance that their reaction, although distinct, was a little less prompt, and that the complete settling of the agglutinated and motionless clumps and clearing of the fluid was a little tardier. Vibrios II., III., IV., and V. on the other hand gave no agglutinating reaction.

On carrying all these vibrios through many successive generations in oyster gelatine no modification was noticed in reaction to cholera serum as regards vibrios I., II., VI., VII., or VIII.; but as regards vibrios III., IV., V., and IX., particularly as regards vibrio III., a distinct alteration took place.

Vibrios IV. and V. were in marked contrast. Beginning with the ninth generation in oyster gelatine, 1 c.c. of bouillon emulsion of the scraping of the growth in each instance from the surface of agar that had been incubated at 20° C. for 48 hours, and to which 0·25 c.c. of cholera serum was added, showed under the microscope already after 15 minutes distinct aggregation into clumps and arrest of movement. On naked-eye inspection, however, this clumping and separation was not noticeable in vibrio IV., whereas it commenced with vibrio V. after 25 minutes, and in three hours was complete, so that the fluid had become practically clear, with a thick white sediment. With vibrio IV., indeed, no naked-eye aggregation and separation was observable, even after the seventeenth generation in oyster gelatine.

Vibrio III. for the first time re-acted positively in its fifteenth generation in oyster gelatine. A strongly turbid emulsion made from the surface of an agar culture, grown at 37° C. for 24 hours, to which 0·10–·25 c.c. of serum was added for each c.c. of emulsion, showed pronounced agglutination under the microscope already in five minutes; and to the unaided eye aggregation and separation was distinct in 25–30 minutes, though even after two hours the fluid had not become quite clear. Vibrio III. from a twenty-fifth generation in oyster gelatine culture responded fairly well to the serum test, agglutination being nearly as rapid and distinct under the microscope as with the St. Petersburg

cholera vibrio. To the naked eye also aggregation and separation was very obvious, though retarded as compared with the St. Petersburg vibrio; moreover, the fluid did not become quite clear in three hours, notwithstanding that a voluminous sedimentation took place.

In regard of vibrio IX., when passed through successive generations in oyster gelatine, a diminution in the rapidity of the agglutinating action of cholera serum was observed as compared with that producible on this vibrio from a stock culture. If agar cultures were made at the same time from the vibrio of both sources, and emulsions thereof tested under the same conditions and with the same amount of cholera serum, it was found that although vibrio IX. from oyster gelatine of the twelfth generation gave the reaction in a positive fashion, this reaction was markedly retarded, both under the microscope and to the unaided eye, as compared with that given by vibrio IX. from the stock subculture. Thus, emulsion of vibrio IX. from the twelfth remove in oyster gelatine, when tested with cholera serum (10 per cent.), did not give complete sedimentation until lapse of 90 minutes, whereas vibrio IX. from the stock culture gave, under precisely the same conditions, and with the same serum, complete sedimentation in 30 minutes.

5. *Behaviour to Pfeiffer Test.*—As regards the germicidal serum test *in corpore*, the only change noticed was with vibrio III. This variety gave, at the twenty-fifth generation in oyster gelatine, a positive result. But a considerable amount of serum had to be used. Thus, the scrapings from a twenty-fifth generation of the vibrio on agar, incubated at 37° C. for 48 hours, having been made into an emulsion with 5 c.c. of sterile bouillon, experiments were made as follows:—1 c.c. of the emulsion (*i.e.*, $\frac{1}{5}$ culture) was injected into the peritoneal cavity of a control guinea-pig. Into a second guinea-pig a mixture of 1 c.c. emulsion and of 0·25 c.c. cholera serum from a highly immunised horse was injected intraperitoneally. Into the peritoneal cavity of a third guinea-pig the same amount of emulsion plus 0·5 c.c. of serum was injected. As a result, guinea-pig No. 1 was found dead in 20 hours; guinea-pig No. 2 was dead after 34 hours; guinea-pig No. 3, although quiet, the next day recovered. This experiment was repeated in the above way with the same result. It is, therefore, justifiable to assume that, inasmuch as vibrio III. did not formerly react to the germicidal serum test and now did, it had, by its repeated (25) passages through oyster gelatine culture, become altered; that in this respect, as also in respect of the agglutinating action on it of cholera serum, it had become profoundly changed and brought considerably nearer to the St. Petersburg cholera vibrio, from which it was originally derived.

6. *Behaviour in Milk.*—Vibrio IX. alone became, by passage through successive generations of oyster gelatine, modified as regards its behaviour in milk. This vibrio, like the St. Petersburg vibrio, when growing at 37° C. in sterilised skim or sterilised ordinary milk, does not produce any visible change in the milk within the first three or four weeks. But it was found that while the St. Petersburg vibrio, after passing through a number of successive generations of oyster gelatine remained unaltered in its behaviour in milk culture, this was not the case with vibrio IX., or, as I have called it, vibrio filamentosus. After eight successive transmissions through oyster gelatine vibrio IX. was observed to cause typical curdling of the milk within a week. Moreover, all further subcultures of this vibrio IX. in oyster gelatine retained this power; the clotting, in some instances, by the latter generations being even accelerated. These observations have been repeated several times, a

comparison being made each time between vibrio IX. from oyster gelatine and vibrio IX. from the original stock culture; but the result was always the same, viz, no clotting of milk with vibrio IX. from the stock culture, clotting within eight days with vibrio IX. from oyster gelatine. Subcultures were also made from these milk cultures in ordinary nutrient gelatine, and with such gelatine subcultures the milk experiments were repeated, but always with the same result. So that there can be no doubt that vibrio IX., by its transmission through oyster gelatine for several generations, really acquired a new and seemingly permanent character, namely, power to clot milk.

On the whole, then, though the relatively few new conditions which laboratory work enabled me to employ did not succeed in bringing back to any one of the varieties of vibrio the characteristics of its parent, sufficient evidence has been adduced to show that some of the varieties under one, others under another, condition are capable of becoming so permanently changed as to acquire and retain a character possessed by the typical cholera vibrio but not possessed by them previously. I refer here particularly to the changes produced by cultivation in oyster gelatine with reference to alterations of liquefying power, and to alteration as regards cholera red and serum reaction of vibrio III.

PLATE I.

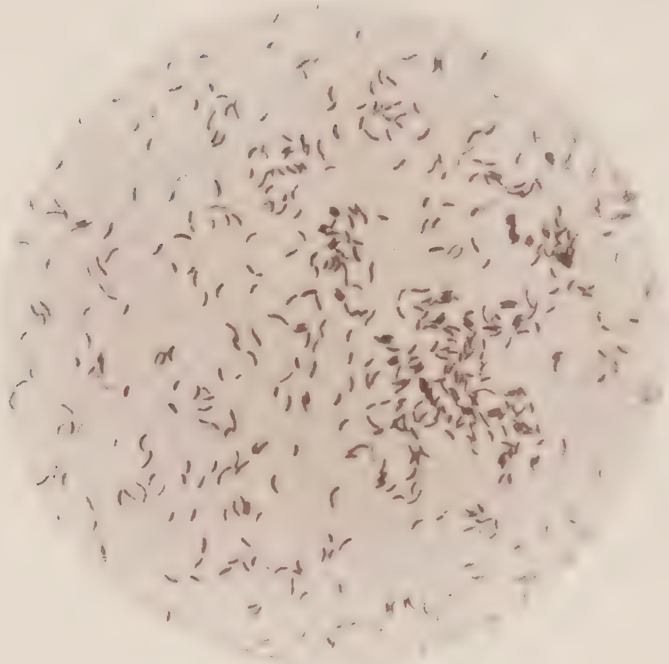


Fig. 1.

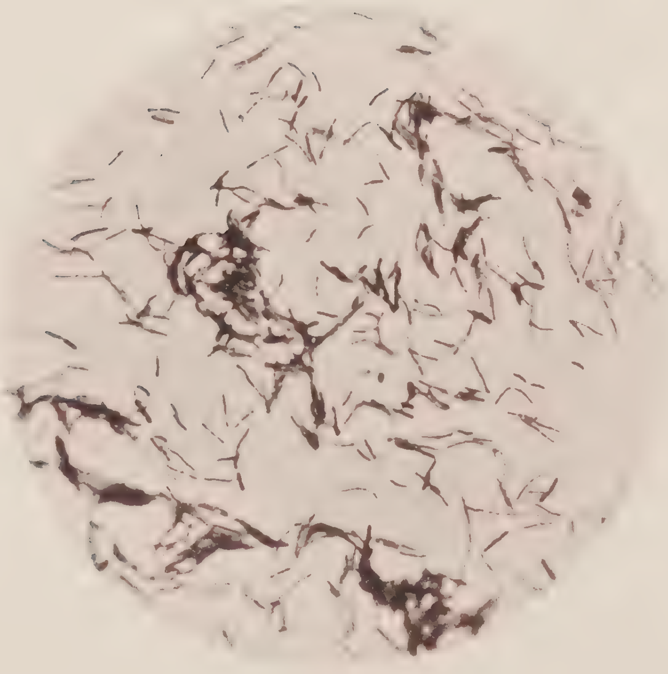


Fig. 2.

CHOLERA VIBRIOS.

PLATE I.

Fig. 1.

The St. Petersburg (Koch's) vibrio: Reproduced from a photograph of a culture of the microbe on agar, incubated for 24 hours at 37° C.

[Magnifying power, 1,000.]

Fig. 2.

Vibrio IX., or vibrio filamentosus: Reproduced from a photograph of a culture of the microbe on agar, incubated for 24 hours at 37° C.

[Magnifying power, 1,000.]

No. 2.

Preliminary Report on the Growth of the Typhoid Bacillus in Soil; by Sidney Martin, M.D., F.R.S.

The object of this investigation has been to ascertain under differing conditions as regards temperature, moisture, and organised constituents, what soils tend to conserve and enhance and what soils tend to destroy and discount the life processes and physiological activities of the typhoid bacillus.

Such investigation is, as shown in this sketch, a very extensive one; the physiological activity, for example, of this bacillus, although of the highest importance, being not yet sufficiently worked at to allow of its being tested with certainty.

In the experiments which will be recorded in this report, the growth of the typhoid bacillus in soil has been studied solely from its vegetative aspect and not in relation to its physiological or pathological activity. Attention has been paid to the kind of soil used as a cultivating medium, to the amount of moisture present, and to the temperature at which the experiment was performed: the question of the physiological activity of the particular culture used being reserved for further experimentation.

The typhoid bacillus although äerobic can be cultivated as an anäerobe and even in an atmosphere of carbonic acid. It grows best, like other pathogenic organisms, at 37° C., but it also grows at lower temperatures and withstands a great degree of cold, for instance 0° C. or even lower temperature. Also it is somewhat resistant to heat. As regards the media in which it grows, it flourishes both in an alkaline and an acid medium, and its resistance to the action of acid and even of a free mineral acid is remarkable. In dry soil and in clothes it has been found by Uffelmann to live for one to two months, a fact which shows the resistant capacity of the micro-organism, but which is not perhaps of much service in consideration of the investigation to be recorded in this report. As regards resistance to external conditions, the typhoid bacillus is closely related to the bacillus coli communis, and on the whole it can be stated that the latter bacillus is more resistant than the former.

It is unnecessary to recapitulate here what is now common knowledge as to the mode of growth of the typhoid bacillus in the ordinary media; but something must be said regarding the tests which have been used for the bacillus in this research. In the investigation, cultures of the bacillus were obtained from two different sources; from Dr. Sims Woodhead of the Conjoint Laboratories and from Dr. Klein. Both showed on cultivation the typical reactions of the typhoid bacillus. Thus in broth each formed a cloudiness, with a deposit, and no scum on the surface. The broth culture gave no indol reaction with sodium nitrite and sulphuric acid. Milk was not coagulated, and in a "shake" gelatine culture no gas bubbles were formed. On potato, the growth

App. B. No. 2.

On the Growth of the Typhoid Bacillus in Soil; by Dr. Sidney Martin.

was usually what was once described as the typical growth of the typhoid bacillus, viz., a filmy, almost transparent, growth; but in both cases some of the cultures on potato became brownish. Cultures were obtained in broth containing Parietti's fluid of varying strength. Further tests of the bacillus were the investigation of its motility in the hanging drop; the application of the serum test, and the investigation of the number of flagella present. In performing the serum test a sample of typhoid antitoxic serum was used, which had been kindly sent to me by Dr. Bullock of the British Institute of Preventive Medicine. It acted very well, the clumping of the bacilli taking place either in a few seconds or in a few minutes. The method used for staining flagella was Van Ermengen's.

Characters of the Soils used in the Investigation.

1. Some experiments were performed with samples of soil obtained through Dr. H. Timbrell Bulstrode. Of these there were eight, four of which came from the entourage of houses which had been repeatedly invaded by enteric fever, while other four were obtained from localities where enteric fever had not occurred within the memory of those living. This distinction from the point of view of present purposes was not found of any very great importance, although the source of the soil was kept in mind during the investigation. All these samples of soil may be described as black garden mould, in which numerous micro-organisms were present and living. Cultures were made from two of them, and various forms of bacteria were obtained, some liquefying and some not liquefying gelatine. The exact nature of these micro-organisms was not investigated, as it was considered somewhat beyond the scope of the present research. Besides this, the soil was extremely offensive, showing that it contained a large quantity of putrefying animal matter. The presence of this animal matter, and the circumstance that large quantities of micro-organisms were growing in it, are the two chief facts which are of importance in considering the results obtained. This soil will be referred to later as organically contaminated soil.

2. Other samples of soil were obtained from a locality in Hampshire which was distant from any habitation; it had never been under cultivation or manured. This virgin soil was obtained from three depths; a top soil in which heather was growing, consisting of peat; a sub-soil, locally called "rust," which forms a hard and almost impermeable crust covering the third soil, which consists of red sand. The sample of this red sand was taken about 2½ feet from the surface. In the investigation both the "rust" and the red sand were used as culture media for the bacillus. As regards the character of the "rust," it emitted no odour and was crumbly, having somewhat the physical characteristics of peat mixed with sand. Both it and the red sand were readily sterilised by steaming, and although, in the condition in which they arrived, they contained a few micro-organisms, yet there was nothing like the number which was present in the samples of organically contaminated soils. It is not improbable indeed that if they had been investigated on the spot they would have been found to have been

relatively sterile, as it has been shown that at a depth of 1 to $1\frac{1}{2}$ metres in soil no living germs were obtained. (Fränkel.) The samples of organically contaminated soil were with great difficulty sterilised by steaming, although they could be readily sterilised in the autoclave.

A.—Experiments with Sterilised Soil containing a large quantity of Organic Matter (organically contaminated soil).

In preparing this particular soil as a culture medium it was found impossible to utilise it in the original state in which it arrived, inasmuch as it was mixed with stones, bits of crockery, and various other débris. It was therefore sifted and dried at a temperature below 37° C., and ground into a powder. This fine powder was then placed in Erlenmeyer flasks, to the depth of about 1 to 2 inches, and distilled water added till the soil was just moist. The flask containing the moist soil was then sterilised, and the sterility of its contents was tested by cultivating a small portion in broth. The surface of soil in each flask was about 3 inches in diameter, and in depth from 1 to 2 inches; but there was no surface moisture, the soil being simply damp. Care was taken that there should be no surface moisture, inasmuch, as if there were any excess of water, the bacilli might exist independent of any effect the soil might have on them.

Cultivation of the Typhoid Bacillus in Soil for 16 *Days at* 37° *C.*

Experiment No. 1.

Two Erlenmeyer flasks were prepared, in the manner described, with the soil, and after sterilization they were each inoculated with 1 c.c. of a broth culture of the bacillus of 24 hours' growth. Care was taken that none of the liquid splashed away from the centre, as it was desired to test whether the bacillus spread from the centre to periphery. At the end of 16 days the soil was tested for the presence of the bacillus, by taking small portions of it from the centre, where the inoculation had been made, and from the side at three places near the edge of the inside of the flask, as in Fig. 1. The cultures were made in broth, as by this means the vitality of the bacillus could be at once tested by means of a hanging drop. Moreover the broth could be utilised further for making subcultures on agar and potato. The results are shown in the following statement:—

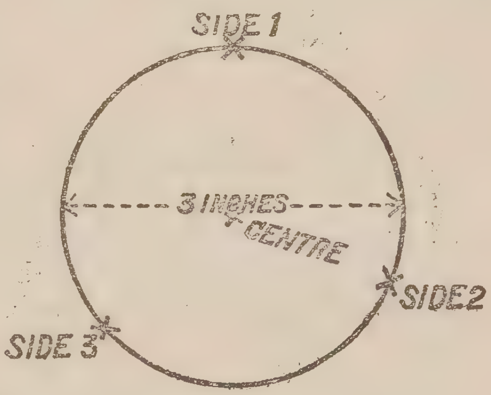


Fig. 1.—Showing the places where the soil was tested.

Flask 1.

Centre of soil.—After two days' cultivation of the soil in broth at 37° C., on examination in a hanging drop, numerous bacilli, both short and of medium size, were seen, actively motile. Subcultures were made on agar and potato. The growth on the latter was filmy, not coloured, and, on examination by staining, was shown to be of pure growth of the bacillus. No indol was formed in the broth.

Side 1 of soil.—After two days' incubation the broth was still clear, and in a hanging drop only two or three actively motile rods were seen. Subcultures on agar gave no growth, but on potato a a thin filmy growth. Other cultures were made subsequently, and showed that the bacillus was by no means active in its growth, and the result formed a great contrast to that obtained from the centre of the soil.

Side 2 of soil.—After two days' incubation the broth became turbid, and a hanging drop showed very numerous medium and short bacilli, actively motile. Subcultures on agar and potato gave a copious and pure growth on each, that on the potato being colourless. No indol formed in the broth.

Side 3 of soil.—After two days' incubation the broth showed a turbidity which was due to numerous actively motile bacilli. The subcultures on agar and potato were copious, and showed microscopically a pure culture of the typhoid bacillus. No indol formed in the broth.

It is thus seen in this experiment, that in 16 days, at a temperature of 37° C., the typhoid bacillus was not only alive, but had spread $1\frac{1}{2}$ inches from the centre to the periphery. The amount of moisture in this soil was 35·1 grammes per cent. There was no free liquid on the surface, so that the bacillus had spread through the soil itself, and not simply through water.

Flask 2.

The soil in this flask was from another locality than that in the first, although, like it, it contained a large quantity of offensive organic matter. The incubation at 37° C. lasted for 16 days, as in the first case, and cultivations in broth were made from the centre of the soil, as well as from the side at three places.

Centre of soil.—The broth became turbid, and examination, by a hanging drop, revealed a large number of moderately active medium-sized bacilli, some of them forming long threads which showed, in parts, plasmolysis. A second broth culture was made from the first, and in 24 hours was tested with typhoid serum, with the result that the bacilli clumped in a few minutes. No indol developed in the broth.

$\left.\begin{array}{l}\text{Side 1 of soil.}\\ \text{Side 2 of soil.}\\ \text{Side 3 of soil.}\end{array}\right\}$ Cultivations gave negative results.

The growth of the typhoid bacillus in this soil differed from that in the first in the fact that the micro-organism, although alive in 16 days, did not spread from the centre to the periphery. This soil contained more moisture than that in Flask 1., viz., 40·3 grammes per cent. There was no surface liquid. It evidently was not so favourable a medium as the first for the growth of the bacillus. There may have been some difference in composition of these soils.

Experiment No. 2.

It was thought that, instead of inoculating the centre of the flask containing the soil with a broth culture, it would be a better test of the growth of the bacillus if an agar culture were used. An agar culture four days old was therefore now employed, and the platinum needle

simply laid along the length of the culture before being used for inoculation of the soil. The inoculation was made in the centre of the soil by the needle being held vertically and thrust to the bottom of the flask. In this way no splashing could have occurred, such as might have happened when the centre of the soil was inoculated with the broth culture. The soils used in Flasks 3 and 4 were from different localities.

Flask 3.

After 16 days' incubation at 37° C. (the same period as in the first experiment), the soil was examined in the same way—by making cultivations from the centre, and from the side at three equidistant points in the periphery.

Centre of soil.—The broth became turbid, and revealed, by a hanging drop, long and short rods, actively motile. A subculture in broth was made, and tested after 24 hours with typhoid serum, the bacilli giving the reaction. No indol was formed in the broth.

Side 1 of soil.—Broth became slowly turbid, and showed medium-sized and long bacilli, moderately active.

Side 2 of soil and Side 3 of soil } Cultivations were negative, the broth remaining quite clear.

The growth, therefore, of the bacillus in the soil in 16 days in this flask had spread from the centre to the periphery in one part only; it had not invaded the whole of the soil. The amount of moisture contained in the soil was 38·7 grammes per cent. It was possible however that the growth at the side of the soil was, to some extent, interfered with by the fact that the surface was pitted by the water which had been added.

Flask 4.

This flask, which was inoculated in the same way and at the same time as Flask 3, was also tested in 16 days.

Centre of soil.—In two days the broth was turbid and showed very numerous, short, and very active bacilli. After several days it showed no indol. Subcultures on agar and potato gave copious pure growths of the typhoid bacillus.

Side 1 of soil.—Two days' growth in broth gave exactly the same results as the growth from the centre. Copious pure growths were also obtained on agar and potato. Tested by the typhoid serum, many of the bacilli clumped at once, others more slowly.

Side 2 of soil.—The broth remained apparently clear for two days, and it was only after eight days that definite turbidity appeared, due to numerous very active rods and threads.

Side 3 of soil.—Showed in two days turbidity of the broth, due to numerous, short, and medium, actively motile rods. Pure growths of the bacillus were obtained on agar and potato.

The amount of moisture in this soil was 37·2 grammes per cent. In this case the bacillus had grown more actively than in Flask 3, which contained a somewhat larger per-centage of water. The difference in the rate of growth was, therefore, probably due to some inherent peculiarity of the soil.

App. B. No. 2.

On the Growth of the Typhoid Bacillus in Soil; by Dr. Sidney Martin.

In Experiments 1 and 2 it may be observed that in two of the flasks, viz., Flask 1 and Flask 4, the typhoid bacillus had, in 16 days, spread from the centre of the mass of soil, 3 inches in diameter, to the periphery on all sides, and that in other two flasks, one inoculated with broth and one with an agar culture, the growth of the bacillus was much less active. Both these experiments were, unfortunately, cut short owing to accidental overheating of the incubator.

Cultivation of the Typhoid Bacillus for 105 *days at* 37° *C.*

Experiment No. 3.

Another sample of soil of the same general character as those used in Experiments 1 and 2, but from a different locality, was placed in each of two Erlenmeyer's flasks, the depth of soil being about 1 inch and the diameter of its surface about 3 inches. Each flask was inoculated in the centre of the soil with a broth culture 24 hours old.

Flask 5.

Was inoculated with about 1 c.c. of the broth culture and incubated at 37° C.

First Testing, 14 *days after Inoculation.*—Cultivations were made on gelatine plates from the centre and from one part of the periphery. From the centre cultivation, numerous colonies of the typhoid bacillus in the depth and surface were found. Subcultures were made from these in broth, and subsequently on agar and potato; the growth on agar was pure, and showed, on microscopical examination, actively motile rods; that on potato was filmy and slightly brown subsequently. The broth cultivation after some days gave no indol reaction. The cultivation from the periphery showed on the gelatine plate one or two colonies like the typhoid bacillus. But no definite results were obtained by subculture from these, so that, at any rate, it was to be inferred that no great extension of the bacillus had occurred through the soil in 14 days.

Second testing, after 36 *days' incubation at* 37° *C.*—The method of testing direct from the soil into gelatine was not considered satisfactory; so the soil was tested in broth tubes. In this second testing the broth became turbid in 24 hours and showed, microscopically, actively motile rods, short and long, some forming threads; subcultures made on agar and gelatine (shake) gave characteristic growths of the typhoid bacillus. The bacillus was, therefore, still alive in 36 days.

Third testing, 49 *days' incubation at* 37° *C.*—Cultures in broth were made from the centre and from the periphery at one part. The cultivation from the centre showed turbidity of the broth at the end of two days; and in the hanging drop, short actively motile rods and long threads were discovered. Subcultures were made on potato on which no growth occurred; on a gelatine plate, in which numerous colonies of the typhoid bacillus were found; and on agar on which there was a pure and copious growth of the bacillus. The cultivation from the periphery of the soil showed turbidity of broth in the same time as that from the centre, the broth containing actively motile short rods and long threads. The

subcultures on potato yielded a growth which was slightly yellowish; a copious growth occurred also on agar, but no colonies developed in the gelatine plate. In 49 days therefore the bacilli were still alive and active, and had spread from the centre of the soil to the periphery at one part.

Thirty days after this testing, the incubator, in which the flasks were contained, was found to have become overheated during the night. This accident, which killed the bacillus in Experiments 1 and 2, did not destroy it in Experiment 3. After regulating the incubator the flasks in Experiment 3 were again placed in it.

Fourth testing, after 79 days' incubation at 37° C.—Cultures were made from the centre of the soil and from the periphery at two opposite parts. Of the first tubes made, two became contaminated with organisms from the air. A fresh testing was therefore performed which gave the following results:—In the cultivation from the centre the broth became turbid, and in the hanging drop long and short rods were found, not very active. From an agar subculture, 24 hours old, a preparation was made and stained for flagella, which were found very numerous around the rods.

In cultivation from Side 1 (*see* Fig. 2) the broth became turbid, and showed, in the hanging drop, long and short actively motile rods which gave a pure subculture of typhoid bacillus on agar. A subculture of 24 hours in broth was tested with typhoid serum and the clumping of the bacilli occurred immediately. In the cultivation from Side 2, the same reactions in broth, as in the case of Side 1, were shown, and the bacilli showed the characteristic flagella from an agar subculture. The long threads which were found in the broth tubes showed well-marked plasmolysis, but the majority of the bacilli were quite normal medium sized rods. None of the broth tubes gave the indol reaction.

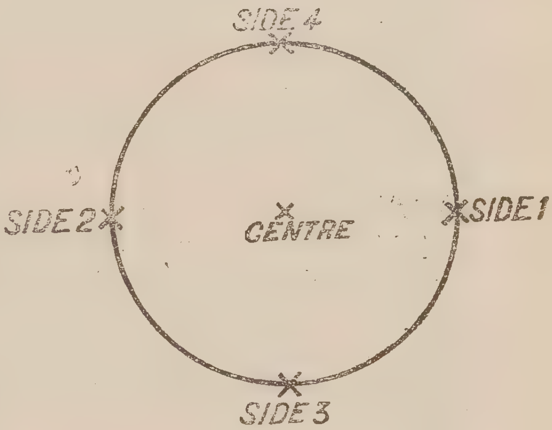


Fig. 2.—Showing parts of soil tested in Experiment 3, Flasks 5, 6.

In 79 days, therefore, the bacilli were still alive and active.

Fifth testing, 105 days' incubation at 37° C.—The soil was tested at two parts in the periphery, other than those previously taken, as shown in Fig 2.

Side 3.—The broth became cloudy, and showed, in the hanging drop, rather long but actively motile rods.

Side 4.—This showed the same as Side 3 in cultivation.

The bacilli had therefore at this date, that is after 105 days or 15 weeks, not only retained their vitality in the moist soil, but spreading from the centre of the disc, 3 inches in diameter, had pervaded the whole of the soil. The amount of moisture present in the soil in this flask was 35·9 grammes per cent. The surface of the soil was smooth and there was no excess of moisture on it. At the end of this period of 105 days subcultures were made to see whether the bacillus retained its vegetative and cultural peculiarities. On potato, the subculture from

App. B. No. 2.

On the Growth of the Typhoid Bacillus in Soil; by Dr. Sidney Martin.

broth was filmy and colourless as in the original culture added to the soil. On agar there was a copious and pure growth. In milk there was no coagulation, and in a shake-gelatine culture numerous colonies formed without gas bubbles. This specimen of soil therefore not only did not destroy the bacillus, but served as a cultivating medium for it. The bacillus had grown and pervaded the whole of the mass of the soil and retained its vegetative properties intact.

Flask 6.

This flask contained the same kind of soil as Flask 5, but was inoculated, in the centre, and by means of a capillary pipette, with eight drops of a broth culture 24 hours old. The soil received therefore much less than the 1 c.c. used in inoculating Flask 5. The experiment was performed to test the question of the quantity of the inoculating material in relation to the rapidity of growth in the soil. The amount of moisture present in the soil was 37·7 grammes per cent., about the same as in Flask 5. The surface of the soil was smooth and there was no surface liquid.

First testing, after 14 *days' incubation at* 37° *C.*—Portions of soil both from the centre and from one part of the periphery inoculated on gelatine plates showed numerous colonies of the typhoid bacillus so that even in 14 days the bacilli had spread to the periphery.

Second testing, 36 *days' incubation at* 37° *C.*—The centre of the soil was tested in broth, and short actively motile rods developed.

Third testing, 49 *days' incubation at* 37° *C.*—A cultivation was made in broth from the centre and from the periphery at one part. In both cases the broth became turbid and showed short rods and long threads, moderately motile. In subcultures on potato, no obvious growth developed. On gelatine plates numerous colonies developed from both broth cultivations.

Fourth testing, 79 *days' incubation at* 37° *C.*—Cultivations were made from the centre of the soil and from two parts of the periphery opposite to each other, as in Fig. 2, Sides 1 and 2. In all three broth tubes actively motile rods developed. Subcultures were made on agar; a pure growth was obtained, which, when stained for flagella, presented the characters of the typhoid bacillus.

Fifth testing, 105 *days' incubation at* 37° *C.*—Cultivations were made, as with Flask 5, from two portions of the periphery of the soil opposite to each other and between the two points previously tested (*see* Fig. 2). In both, the broth cultures showed numerous actively-motile rods, which, when cultivated on potato, on agar, in milk, and in "shake" gelatine, gave pure and copious growths of typhoid bacillus. In this flask, then, as in Flask 5, the bacilli inoculated into the centre of the soil had, in 105 days, pervaded the whole soil, and still retained their vitality as well as their cultural charateristics.

The experiment is still progressing, inasmuch as it is desired to see how long the typhoid bacillus can exist in soil. Proof is definitely given, both in this experiment and in the first two, that the typhoid bacillus not only can exist in this particular kind of soil, but can grow and pervade it at a temperature of 37° C.

Growth of the Bacillus Coli Communis in Soil at 37° C., compared with that of the Typhoid Bacillus.

Experiment No. 4.

An experiment was undertaken in which sterile soil was used as a cultivating medium for the bacillus coli, for the purpose of contrasting the results with those previously obtained with the typhoid bacillus. The soil used was of the same general character as that used in Experiments 1, 2, and 3; that is, it was surface mould containing a large quantity of organic matter. It contained 44·8 grammes per cent. of water, although there was no free water on the surface. The soil was inoculated in the centre by means of a freshly-made glass pipette with ½ c.c. of a 24 hours broth culture of the bacillus coli. The soil was in an Erlenmeyer flask of the size previously described. This flask was placed in the incubator for 28 days, and then tested by making cultivations in broth from the centre and from three equidistant parts of the periphery. They all showed in 24 hours the same appearances; viz., the broth was turbid and showed a slight deposit, and, after a few days, a scum formed on the surface of the broth. All these broth tubes gave a pronounced indol reaction with nitrite of sodium and sulphuric acid. Subcultures were made from each on a potato-gelatine and on agar plates. All the plates showed numerous colonies of the bacillus coli, and pure cultures were obtained on the agar. On potato, cultures were obtained of the bacillus in all cases. In one, however, the potato in one part showed the growth of the potato organism. The cultures of the bacillus coli varied from whitish yellow to buff in colour. One of the cultivations from the periphery of the soil was inoculated into two tubes of milk, both of which were coagulated in 24 hours.

The experiment shows, therefore, that the kind of soil under consideration acts as well as a cultivating medium for the bacillus coli as it does for the typhoid bacillus; and that the bacillus coli not only flourishes in it, but rapidly pervades the soil, retaining its cultural and other peculiarities.

Growth of the Typhoid Bacillus in Soil at a Temperature from 15° to 19° C., and exposed to diffused Daylight.

Experiment No. 5.

This experiment was performed for the purpose of ascertaining the growth, at ordinary temperature (as compared with 37° C.) of the typhoid bacillus in soil containing, as in the previous experiments, a large amount of organic matter; in circumstances that is approximating more nearly to the natural conditions in which the typhoid bacillus may be found in soil.

The soil used was from a locality different from any of those at which soil had been previously obtained. It was treated exactly in the same way as in the previous experiments, namely, it was sterilised and water was added. The amount of water it contained was 35·9 grammes per cent., about the same as in the Experiment 3, in which the typhoid bacillus lived 105 days. The soil was inoculated in the centre with ½ c.c. of a 24 hours' broth culture of the typhoid bacillus.

First testing, after 53 *days at the Temperature of the Laboratory.*—Cultivations were made from the centre of the soil and from the periphery at three equidistant parts. Of these the only one in which the broth tube showed turbidity was that from the centre of

App. B. No. 2.

On the Growth of the Typhoid Bacillus in Soil; by Dr. Sidney Martin.

the soil. In the three cultivations from the periphery the broth remained quite clear, and no micro-organisms developed in over 10 days of observation. In subculture on gelatine plates and in broth, of the growth from the centre, a pure growth of the typhoid bacillus was obtained, showing actively motile rods. A pure subculture on agar was also obtained.

Third testing, after 63 *days.*—Cultivation was made from the centre of the soil, and at about $\frac{3}{4}$ inch from the centre, as in Fig. 3.

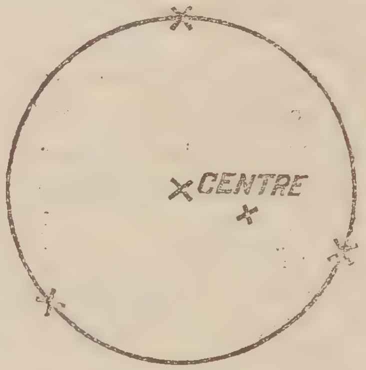


Fig. 3.—Showing places of testing of soil in Experiment 5.

In 24 hours, both broth cultures became turbid, and showed, in the hanging drop, numerous short and medium-sized and very active rods. Subcultures on agar showed a pure growth of the typhoid bacillus in each case.

The bacilli were, therefore, still alive and active at the end of 63 days, and had begun to pervade the soil. The growth had not extended to the periphery of the soil as occurred by this time in the experiments performed at a higher temperature (37°), more favourable to the development of the bacillus. The experiment is being continued, so that it will be seen later how rapidly the bacillus will pervade the soil and how long it will live therein.

B. Experiments on the Growth of the Typhoid Bacillus in Sterilized Virgin Soil, sandy and peaty.

The "Virgin" soil employed in this experiment has been already described. The two strata which were used, in separate flasks, were the so called "rust," which consisted of firm, crumbling, peaty soil, and the red sandy soil from below it. The "rust" was crumbled fine, and placed in its flask to a depth of about $\frac{1}{2}$ an inch, the diameter of the surface being 3 inches. The sandy soil was of the above-mentioned depth and the same diameter as the other soil. The growth of the typhoid bacillus used for inoculation was a very vigorous one. It was a subculture on agar two days old from a stock tube which had previously been used in Experiments 1, 2, and 4. Each flask was inoculated with a small quantity of the culture on the end of a platinum rod which was pushed to the bottom of the flask.

Growth of the Typhoid Bacillus in Virgin Soil at 37° *C.*

Experiment 6.

First testing, after 14 *days' incubation at* 37° *C.*—Cultivations were made from the centre of the soil in each of the two flasks; also, in each instance, from three points in the periphery equidistant from each other. But the broth remained quite clear during more than 10 days observation, no micro-organisms whatever growing, whether from the first point of the inoculation of the soil or from the periphery.

Second testing, after 23 *days' incubation at* 37° *C.*—Cultivation was made from the centre of the soil in each flask. No growth of the typhoid bacillus occurred in either of the broth tubes.

Growth of the Typhoid Bacillis in Virgin Soil at the Temperature of the Laboratory, 15° to 19°; instead of 37° C.

EXPERIMENT 7.

The two flasks containing the same kind of soils as in Experiment 6 were employed, and they were inoculated in exactly the same way from the same culture.

First testing, 20 *days after inoculation.*—Cultivations were made from the centre and from one part of the periphery in each flask; but the broth remained perfectly clear, no micro-organisms whatever growing.

Second testing, 23 *days after inoculation from Centre of the Soil in each Flask.*—No growth of the typhoid bacillus occurred in either of the broth tubes.

Growth on Virgin Soil of Bacillus Coli Communis instead of the Typhoid Bacillus: incubated at 37°.

EXPERIMENT No. 8.

The culture of the bacillus coli used for this experiment was a two days' growth on agar; and the inoculation was made in the centre of the soil, which was in flasks of the same size as those which had been used throughout the investigation. The flask containing the "rust" soil was rather dry, due to an oversight in the preparation of the soil; the other flask contained about as much moisture as in the other cases and as in Experiments 1–5.

First testing, after 14 *days' incubation at* 37° C.—Cultivations were made from each flask in broth from the centre of the soil; also in each instance from three parts of the periphery equidistant from each other. In none of the tubes did the broth become cloudy, and no micro-organisms developed during more than 10 days observation.

Second testing, after 23 *days' incubation at* 37° C.—A culture was made from the centre of the soil in each flask; but no growth of the bacillus occurred.

These two kinds of virgin soil, therefore, present a marked contrast to the black mould containing organic matter, which was used in Experiments 1 to 5. In Experiments 1 to 5 both the typhoid bacillus and the bacillus coli communis not only retained their vitality, but all their cultural characters during a period, in one instance, of 15 weeks; whereas in none of the experiments with this virgin soil did any growth whatever occur either of the typhoid bacillus or the bacillus coli. The experiments are of necessity being repeated; but the results which have been so far recorded offer such a marked contrast between the growth of these micro-organisms in organically contaminated soil and in virgin soil as to point to the distinction between these soils as being one of prime importance.

Although in the commencement of this research only sterile soil has been employed, and on a comparatively small scale, it is evidently of importance to ascertain the effect on the growth of the typhoid bacillus of any co-existing micro-organisms in the soil. These may *à priori* either

App. B. No. 2.

On the Growth of the Typhoid Bacillus in Soil: by Dr. Sidney Martin.

aid its growth or diminish it. This is one of the points which may, perhaps, with advantage, be taken up in a subsequent research. It is evident, however, that practical conclusions will be more readily made from experiments done on a larger scale; that is, with larger quantities of soil and at varying temperatures of the air, as well as under conditions in which the soil is exposed to sunlight, or is completely screened from it.

No. 3.

REPORT on the BEHAVIOUR of the TYPHOID BACILLUS in MILK; by Dr. EDMUND CAUTLEY.

App. B. No. 3.

On the Typhoid Bacillus in Milk; by Dr. Cautley.

It is now a well-recognised fact that typhoid fever is not unfrequently spread by milk; several epidemics have been traced to infected milk. It becomes, therefore, of considerable importance to ascertain how long milk, which has become infected with the typhoid bacillus will retain its infectivity, when this milk is kept under the ordinary conditions which prevail in this country. Further, it is of importance to remember that various articles of food, *e.g.*, ordinary cheese and some of the so-called cream cheeses, are prepared from milk which has undergone curdling, and that if the typhoid organism can live under conditions which lead to the curdling of milk, it follows that these articles of food may be the source of some of the cases of typhoid fever the origin of which cannot be traced.

Up to the present time the observations carried out with a view to the elucidation of this problem have not been of a sufficiently decisive character, on account of the difficulty in differentiating the varieties of the bacillus coli from the typhoid bacillus. The recent investigations of Klein, Elsner, and others, now enable us to separate these organisms without liability to error.

In this investigation the tests relied on to distinguish the typhoid bacillus were:—(1.) The characters of its growth on the surface of gelatin; (2.) The non-production of gas in gelatin shake cultures; (3.) The absence of indol production in broth cultures; (4.) The fact that it does not cause the curdling of milk.

The milk used in this inquiry was in each instance obtained from the same shop on the morning of the day on which each separate investigation was commenced.

Method of Investigation.—In the first place by means of plate cultures it was ascertained to what degree it was usually necessary to dilute the milk in order to enumerate the number of organisms present. To a certain extent this varied with the external temperature. It will be noticed from what follows that a very much larger number of organisms are to be found in milk during hot than in cold weather. As a general rule it was found necessary to dilute the milk with 50 times its bulk of water. The steps usually adopted were as follows: The milk, as soon as obtained, was poured into a clean beaker and covered with a glass plate. After stirring it with a sterile glass rod, 100 c.m. were withdrawn and mixed in a sterile glass dish with 5 c.c. of sterile water. Five cubic millimetres of this mixture were used in the preparation of each plate. The culture media employed in the preparation of the plates consisted, firstly, of gelatin; secondly, of phenol gelatin prepared by the addition of 100 c.m. of a 5 per cent. solution of phenol to 10 c.c. of gelatin; and, thirdly, of potato gelatin prepared according to Elsner's method.

After the plate preparations had been made from the milk, the growth from a culture of the typhoid organism on gelatin, of about the same age and virulence in each case, was added to 250 c.c. of the undiluted milk, and a corresponding series of plates was made in a similar manner from the milk thus infected, care being taken to stir the milk thoroughly in order to disseminate the organism. The milk was

App. B. No. 3.

On the Typhoid Bacillus in Milk; by Dr. Cautley.

then kept at the ordinary temperature of the room, except where otherwise stated, in a glass beaker covered by a glass plate, and a similar series of plates was prepared in a like manner on subsequent days. From these plates the number of organisms present in the original milk, the number present in the infected milk, and the proportion of the organisms present in the milk which were delayed in their growth or were inhibited by the addition of phenol, were, in each instance, determined. Also from these plates numerous subcultures were made from all, or from a large number of, the colonies which resembled the typhoid organism in their mode of growth: so as to ascertain, in the first place, at how long an interval, after the introduction of this bacillus into the milk, it was still living; and, secondly, to ascertain if the bacillus had increased or diminished in number under these conditions.

In some of the investigations plates were also made by smearing, by means of a sterilised platinum spatula, a fraction of the diluted milk on the surface of culture media, which had been poured out into plates and allowed to set. This method is of value in determining the presence of the typhoid bacillus, but is of course no use for the purposes of enumeration.

A few observations were also made on the duration of the life of the typhoid bacillus in sterile milk in the presence of such common micro-organisms as bacillus lactis aërogenes, oïdium lactis, and yeast.

The following account is a short epitome of the investigation, carried on as here set forth, and of the results obtained.

A.—*Preliminary Experiments.*

(1.) *Undiluted Milk.*—5 c.m. used for each plate. Two plates made with each of the three nutrient media.

a. Gelatin.—The colonies which grew were too numerous to be counted.

b. Phenol Gelatin.—Fewer colonies developed than in the gelatin plates, but they were too numerous to be counted.

c. Potato gelatin.—An average of 89 colonies developed; equivalent to 17,800 per c.c. in the original milk.

It was obvious, therefore, that the milk required considerable dilution in order to render it possible to estimate the number of organisms present.

(2.) *Milk diluted* 1 *in* 101.—100 c.m. were added to 10 c.c. of sterile water, and 5 c.m. of the diluted milk used for each plate—two plates of each kind being made. The number of colonies here recorded is the mean of two plates.

a. Gelatin.—42 colonies, including 10 liquefying organisms. Therefore, 848,400 colonies per c.c. of undiluted milk.

b. Phenol Gelatin.—Nine colonies, three of which liquefied. Therefore, 181,800 colonies per c.c. of undiluted milk.

c. Potato Gelatin.—No colonies.

Thus the addition of phenol delayed or prevented the growth of 78·5 per cent. of the organisms present in the particular milk, and potato gelatin proved a bad nutrient medium for all the organisms there present.

(3.) *Milk diluted* 1 *in* 51.—100 c.m. were added to 5 c.c. of sterile water, and a similar series of plates made.

a. Gelatin.—299 colonies, of which seven liquefied. Therefore, 3,049,800 colonies per c.c. of undiluted milk.

b. Phenol Gelatin.—85 colonies, one of which liquefied. Therefore, 867,000 colonies per c.c. of undiluted milk.

c. Potato Gelatin.—These plates liquefied on account of the high external temperature.

Thus the addition of phenol delayed or prevented the growth of 71·5 per cent. of the organisms present in this sample of milk, while potato gelatin proved a bad medium for the purpose of isolating and counting the colonies during hot weather.

B.—*Unsterilised Milk to which Typhoid Bacillus was added.*

(4.) Milk, sample of which was obtained on July 3rd, 1896—

Uninfected milk diluted 1 *in* 51.—*a.* Gelatin.—796 colonies, of which 20 liquefied. Therefore, 8,119,200 colonies per c.c. of undiluted milk.

b. Phenol Gelatin.—The colonies could not be satisfactorily counted on account of the partial liquefaction of the gelatin owing to the hot weather. There was, however, a very much smaller number than in the gelatin plates.

c. Potato Gelatin.—Six colonies, five of which liquefied.

The enormous number of micro-organisms present was, no doubt, due to their rapid multiplication in the milk previous to examination, in consequence of the high external temperature.

Infected milk diluted 1 *in* 51.—To 250 c.c. of this same milk, after the preparation of the above plates, the surface growth of a culture of the typhoid bacillus on gelatin, kept for seven days at 20° C., was added and a similar series of plates were made. The results did not prove very satisfactory as the hot weather caused partial liquefaction of the plates, and the colonies could not be accurately counted.

This sample of infected milk (4.), after having been kept at the room temperature for 24 hours, was completely curdled. It was now well stirred and another series of plates made. This last series showed an enormous multiplication of the microbes present in the milk and considerable liquefaction. It was found impossible to count the number present, and though a large number of subcultures were made from colonies which looked like typhoid colonies, this organism was not recovered.

(5.) Milk, sample of which was obtained on September 25th, 1896—

Uninfected milk diluted 1 *in* 51.—*a.* Gelatin.—70 colonies, including three of bacillus coli and one liquefying colony. Therefore, 714,000 colonies per c.c.

b. Phenol Gelatin.—71 colonies, including one sarcina lutea and three staphylococcus aureus.

c. Potato Gelatin.—10 colonies, two of which were moulds.

Thus, in this instance, the phenol did not appear to inhibit the growth of the microbes present in the milk.

Infected milk diluted 1 *in* 51.—A surface growth of the typhoid bacillus on gelatin, kept for nine days at 20° C., was added to 250 c.c. of the original milk after the above plates were made, and another series of plates were made as before.

a. Gelatin.—1,324 colonies, three liquefying.

b. Phenol Gelatin.—1,291 colonies, none liquefying.

c. Potato Gelatin.—143 colonies, one mould.

This infected milk was then kept at 20° C. for 24 hours, diluted as before, and similar plates made.

a. Gelatin.—The colonies too numerous to be counted, many liquefying.

b. Phenol Gelatin.—The same results.

c. Potato Gelatin.—About one-tenth the number of colonies which were present in the previous plates; many of the colonies were liquefying.

Several subcultures of the typhoid organism were obtained from these phenol and potato gelatin plates. The number of typhoid colonies was much greater in the phenol plates than in the potato gelatin plates.

In this experiment the amount of phenol added did not suffice to delay the growth of the organisms to the extent of enabling an enumeration to be made; probably, too, the multiplication had been greater at 20° C. than it would have been at the room temperature.

(6.) Milk, a sample of which was obtained on October 1st, 1896—

Uninfected milk diluted 1 *in* 51.—*a.* Gelatin.—80 colonies; one bacillus coli. Therefore, 816,000 colonies per c.c. of undiluted milk.

b. Phenol Gelatin.—32 colonies; three of sarcina lutea.

c. Potato Gelatin.—13 colonies; two liquefying, and six consisting of a pink torula.

Thus, in this instance, the addition of phenol delayed or prevented the growth of 60 per cent. of the microbes present in the milk.

The original sample of this milk had been divided into equal portions of 250 c.c., A and B To portion A the surface growth of a culture of the typhoid bacillus on gelatin, kept for seven days at 20° C., was now added; and, after thorough mixing and dilution of a portion of it to 1 in 51, a similar series of plates was made.

a. Gelatin.—733 colonies; three of bacillus fluorescens liquefaciens, therefore 7,476,600 colonies per c.c. of the undiluted infected milk. The typhoid colonies on the surface were beautifully isolated.

b. Phenol Gelatin.—657 colonies; one liquefying.

c. Potato Gelatin.—11 colonies; two liquefying, two pink torulæ. No colonies of typhoid.

Both A and B sections of this milk were kept covered with glass plates, in separate beakers, at the room temperature for 24 hours, and at the end of that time a like series of plates was made from each.

In each case the undiluted (A and B) milk was now diluted to a much greater extent, namely, 1 in 501, by adding 100 c.m. to 50 c.c. of sterile water.

a. Gelatin.—All the plates, both of A. and B. milk, contained such a large number of colonies, many of which were liquefying, that they were quite uncountable.

b. Phenol Gelatin.—All the plates yielded a large number of colonies. Those from portion B contained many liquefying colonies. Those from portion A contained 13 liquefying colonies and several which looked like colonies of typhoid bacillus. Subcultures were made from 12 of the colonies which most resembled this microbe, and three of these proved to be typhoid bacillus.

At the end of two days the A portion of the milk was very sour, but only partially curdled. A fresh series of A plates was now made, diluted, as before, 1 in 501.

a. Gelatin.—1,004 colonies; six resembled typhoid bacillus colonies, but proved to be composed of other organisms.

b. Phenol Gelatin.—616 colonies; four liquefying. Six resembled typhoid, and one of these proved to be that microbe.

From this same A milk, kept in the beaker under the same conditions for six days and by that time completely curdled, two phenol gelatin plates were made by smearing over their surface a trace of the exuded serum, by means of a sterile platinum spatula. A large number of colonies

developed in each plate, and out of 12 subcultures made from six separate suspicious colonies in each plate, two proved to be colonies of typhoid bacillus.

Thus the typhoid bacillus was recovered from the infected milk at the end of six days. Only two colonies were, it is true, found, but no doubt this does not indicate the full extent to which this organism was present. A very large number of the bacilli were added in the first instance, between six and seven million per c.c. of original undiluted milk.

It appears from this that the typhoid organism will live in milk, kept under the above conditions, but that it does not multiply as do the other organisms present, and, in fact, diminishes very much in number. Even at the end of two days only one colony was found in four plates.

(7.) Milk, a sample of which was obtained on October 28th, 1896—

Uninfected milk diluted 1 *in* 51.—In this instance the plates were made by smearing a trace of the diluted milk over the surface of the nutrient media employed.

a. Phenol Gelatin.—A moderate number of colonies, none of which caused liquefaction of the gelatin.

b. Potato Gelatin.—More colonies grew than in the phenol plates; inclusive of two of bacillus coli, two of pink torulæ, and three of liquefying organisms.

Infected milk diluted 1 *in* 51.—A typhoid culture, grown for seven days on the surface of gelatin at 20° C., having been added to 250 c.c. of the milk and well mixed with it, a like series (after dilution) of plates was made on the same day. In this instance a double quantity of phenol was added to each plate.

a. Phenol Gelatin.—More colonies grew than in the plates made before the addition of the typhoid culture. Several colonies of typhoid were found, but they did not grow quite characteristically, being more transparent and more granular than is common.

b. Potato Gelatin.—Ten liquefying colonies; one pink torula, no typhoid.

At the end of 24 hours the infected milk, kept in the usual manner, was sour but not curdled. Similar plates (1 in 51 dilution) were made from it. From the two phenol gelatin plates many colonies of bacillus coli and three of the typhoid bacillus were recovered. From the potato gelatin plates neither of these organisms was obtained; many liquefying organisms developed in them.

At the end of three days the infected milk was partially curdled. The usual phenol and potato gelatin plates were made from a portion of it diluted with 100 times its bulk of sterile water.

a. Phenol Gelatin.—Many colonies grew in each plate. Only two caused liquefaction. Many resembled bacillus coli. Two proved typhoid bacillus.

b. Potato Gelatin.—There were a larger number of colonies and a greater proportion of them liquefying than in the potato gelatin cultures of the previous day.

Thus, in this instance, using a different mode of procedure, the typhoid bacillus was recovered from the infected milk at the end of three days; but, as in the last observation, it was present in very small numbers.

(8.) Milk, a sample of which was obtained on November 18th, 1896—

Uninfected milk diluted 1 *in* 51—*a.* Gelatin.—Twenty-eight colonies per plate. Most of them consisted of bacillus lactis, one was proteus vulgaris. Therefore, 285,600 colonies per c.c. of undiluted milk.

b. Phenol Gelatin.—A double quantity of phenol added to each plate. Twelve small colonies only.

Thus the addition of the phenol prevented the growth of 57·1 per cent. of the microbes present in the original milk.

Infected milk diluted 1 *in* 51.—A culture of typhoid on gelatin, kept for seven days at 20° C., having been added to and well mixed with 250 c.c. of the milk, a portion of it was diluted 1 in 51, and gelatin and phenol gelatin plates prepared by smearing a trace of the diluted milk over the surface.

The gelatin plates yielded many colonies of the typhoid bacillus and many liquefying organisms. The phenol gelatin plates yielded many colonies of typhoid bacillus and no liquefying organisms. At the end of six days some of the colonies in the latter plates began to liquefy slowly.

After keeping this infected milk for two days phenol gelatin plates, with a double quantity of phenol added, were made of a 1 in 51 dilution. In two days both these plates yielded, in addition to other organisms, a large number of colonies of typhoid bacillus.

Similar phenol plates were made from the infected milk at the end of six days; and again many colonies of the typhoid organism developed in them, but fewer than in the corresponding plates made four days previously.

Thus, in this instance, the typhoid bacillus was recovered in considerable numbers from milk, which had been kept for six days and which had turned completely sour.

(9.) Milk, a sample of which was obtained on December 6th, 1896—

Uninfected milk diluted 1 *in* 51.—*a.* Gelatin.—28½ colonies, 1½ liquefying; average of two plates. Therefore, 290,700 colonies per c.c. of undiluted milk.

b. Phenol Gelatin.—A double quantity of phenol added in all the phenol plates; 14 colonies, none liquefying.

c. Potato Gelatin.—Four colonies.

Infected milk diluted 1 *in* 51.—The milk had been divided into two portions, A and B, each consisting of 250 c.c. To part A was added the surface growth of a culture of typhoid on gelatin, kept for two weeks at 20° C. After mixing, a portion diluted with 50 times its bulk of sterile water was employed for similar series of plates.

a. Gelatin.—295 colonies, one liquefying; eight colonies of typhoid bacillus growing on the surface; average of two plates.

b. Phenol Gelatin.—142 colonies, none liquefying; 17 of typhoid bacillus growing on the surface; average of two plates.

c. Potato Gelatin.—186 colonies, chiefly typhoid bacillus.

At the end of two days each portion of the original milk was sour but not curdled. A similar series of plates was made from each portion, with a dilution of 1 in 101.

Portion A. *a.* Gelatin.—A large number of colonies; several liquefying; three superficial typhoid colonies in each plate.

b. Phenol Gelatin.—A large number of colonies, including several of typhoid on the surface. Twelve of typhoid in the two plates.

c. Potato Gelatin.—186 colonies; 14 liquefying; several typhoid.

Portion B. *a.* Gelatin.—Colonies innumerable, many liquefying.

b. Phenol Gelatin.—Fewer colonies than in the gelatin plates and none liquefying.

c. Potato Gelatin.—57 colonies; three liquefying.

At the end of seven days, potato gelatin plates were made from each portion of the milk by the method of smearing a trace of milk over the surface of the medium. Many colonies developed in all the plates, rather more in those made from the infected milk. The plates from the infected milk also contained more liquefying colonies, and a few colonies of typhoid bacillus.

Thus in this instance, starting with a milk containing comparatively few micro-organisms by reason of the cold weather, the investigation being carried out at the beginning of December, the following results were obtained. There was a very large increase in the number of microbes at the end of two days, so much so that the difference between the plates made from the infected milk and the original milk was very slight. The typhoid bacillus was recovered from the infected milk at the end of two days from all the plates made, and at the end of seven days it was recovered by the means of potato gelatin plates.

The number of typhoid bacilli in the infected milk at the end of two days cannot be said to have diminished, for in the phenol gelatin plates made from the infected milk, diluted 1 in 51, on the first day 17 colonies of the organism were found on the surface. In the phenol gelatin plates made on the third day from the infected milk, diluted 1 in 101, 12 colonies of the bacillus were found on the surface. These numbers indicate an increase, rather than a decrease, in the total number present.

The typhoid bacillus was recovered at the end of seven days from the milk.

(10.) Milk, a sample of which was obtained on January 12th, 1897—

Uninfected milk diluted 1 *in* 51.—*a.* Gelatin.—14 colonies; four liquefying; sarcinæ, &c. Therefore, 142,800 colonies per c.c. of undiluted milk.

b. Phenol Gelatin.—200 c.m. of a 5 per cent. solution of phenol, added to 10 c.c. of gelatin for each plate. Nine small colonies, none liquefying.

c. Potato Gelatin.—No colonies, except one mould.

Infected milk diluted 1 *in* 51.—To 250 c.c. of this milk there was added the surface growth from a culture of typhoid, grown on gelatin for six weeks at 20° C., and a second series of plates made after dilution 1 in 51.

a. Gelatin.—54 colonies; two liquefying (one sarcina lutea, one bacillus fluorescens); 14 colonies of typhoid bacillus growing on the surface.

b. Phenol Gelatin.—38 colonies; one liquefying.

c. Potato Gelatin.—23 colonies.

As regards these plates a calculation shows that at least 300,000 typhoid bacilli were added to each cubic centimetre of the milk, a very much larger number than of other varieties of microbes already present.

The infected and the uninfected portions of the milk having been kept in the usual manner, at the end of 24 hours, and at the end of 48 hours, corresponding series of plates were made from each, the milk being diluted in the proportion of 1 in 101.

Uninfected milk in 24 hours:—

a. Gelatin.—1,090 colonies, 14 liquefying, could be counted after incubation for two days. In four more days the liquefaction was very considerable.

b. Phenol Gelatin.—55 colonies only present at the end of a week, including one mould; no liquefying organisms.

c. Potato Gelatin.—Only two unimportant colonies.

Uninfected milk at the end of 48 hours:—

a. Gelatin.—A very large number of colonies developed, but only seven of them liquefied the medium.

b. Phenol Gelatin.—19 colonies; one bacillus coli.

c. Potato Gelatin.—Only a single mould grew.

Infected milk at the end of 24 hours:—

a. Gelatin.—2,675 colonies; two liquefying; several looked like typhoid bacillus, and 2 out of 12 which were cultivated proved to be that microbe.

b. Phenol Gelatin.—56 colonies; one liquefying. The typhoid bacillus was not recovered from either of these plates.

c. Potato Gelatin.—38 colonies; two liquefying. The typhoid bacillus was not recovered.

Infected milk at the end of 48 hours:—

a. Gelatin.—Very much liquefaction at the end of two days, due to bacillus fluorescens.

b. Phenol Gelatin.—A large number of colonies at the end of five days, none liquefying. One colony proved typhoid bacillus.

c. Potato Gelatin.—Much liquefaction and many colonies. The typhoid bacillus was not recovered.

The results in this instance were somewhat anomalous. Although only a comparatively small number of microbes were present in the original milk, and a large number of typhoid bacilli were added to it, the latter organism soon disappeared from the mixture. Moreover, it is curious that the number of organisms, other than typhoid, increased to a greater extent in the infected milk. It might be assumed from this that the presence of the typhoid bacillus in milk rendered it a more suitable medium for the growth of the other organisms present.

(11.) Milk, a sample of which was obtained on January 27th 1897—*Uninfected milk diluted* 1 *in* 51.—The plates were made by blowing 5 c.m. of the diluted milk on to the surface of each of the nutrient media, and by smearing it over the surface with a sterile platinum spatula.

a. Gelatin.—22 colonies, six of which were moulds. Neglecting the moulds this gives 163,200 colonies per c.c. of the undiluted milk.

b. Phenol Gelatin.—15 colonies, six of which were moulds.

c. Potato Gelatin.—Several moulds; no other colonies grew.

Infected milk diluted 1 *in* 51.—The surface growth of a gelatine culture of typhoid, kept for three days at 20° C., having been added to 250 c.c. of the milk, a like series of plates was (after dilution) made in the same manner.

a. Gelatin.—A very large number of typhoid bacillus colonies; 14 moulds, and four other colonies developed.

b. Phenol Gelatin.—About the same number of colonies of typhoid bacillus developed as in the gelatin plates, but they were smaller, more granular, and more transparent, and had evidently been somewhat delayed. One mould and seven other colonies of various kinds also grew.

c. Potato Gelatin.—Many colonies of typhoid bacillus, but fewer than in the other plates; one mould.

From the uninfected milk, diluted 1 in 101, a similar series of plates was made after it had been kept for two days, and also at the end of six days. In all these plates so many liquefying colonies rapidly developed that it was impossible to estimate the total number of micro-organisms present on these days.

Similar plates, from dilutions 1 in 101, were also made from the infected milk at the end of two and of six days.

a. Gelatin.—All showed a large number of colonies and rapid liquefaction; the typhoid bacillus could not be isolated.

b. Phenol Gelatin:—

1. After two days; much liquefaction, and many more colonies than in the corresponding plates from the uninfected milk.

A large number of colonies of typhoid bacillus, about half as many as present in the plates made from the milk when first infected.

2. After six days; much liquefaction, but several colonies of the typhoid bacillus were obtained, many fewer than on the third day.

c. Potato Gelatin.—So many liquifying colonies grew that it was impossible to isolate the typhoid bacillus.

Thus, in this instance, a small number of microbes were present in the original milk, a large number of typhoid bacilli were added to it, and at the end of six days a fair number of these bacilli were still in existence in it.

(12.) Milk, a sample of which was obtained on February 16th, 1897—

Uninfected milk, undiluted.—5 c.m. used for each plate.

a. Gelatin.—1,134 colonies, eight of which were liquefying. Therefore, 226,800 colonies per c.c. of the milk.

b. Phenol Gelatin.—1,097 colonies, four of which were liquefying.

All the plates showed a considerable variety of colonies.

Infected milk.—The surface growth of a culture of typhoid on gelatin, kept for four days at 20° C., was added to 250 c.c. of the milk. After mixing, 100 c.m. were added to 5 c.c. of sterile water, and 5 c.m. of the dilution used for each plate.

a. Gelatin.—540 colonies per plate; only one liquefying; equivalent to 5,508,000 colonies per c.c. of milk.

b. Phenol Gelatin.—Almost the same number of colonies, none liquefying. Superficial colonies of typhoid were present in abundance in all plates.

At the end of 24 hours the milk was sour, but not curdled. Plates were made with the above degree of dilution of the milk. Several plates were also made from milk diluted with 250 times its bulk of sterile water.

The results were much the same as those previously obtained. Many liquefying organisms developed, consisting of the bacillus fluorescens, and varieties of proteus vulgaris. Many colonies of typhoid bacillus were found in both the gelatin and the phenol gelatin plates, being more readily isolated in the latter by reason of the smaller amount of liquefaction.

(13.) Milk, a sample of which was obtained on March 10th, 1897—

Uninfected milk diluted 1 *in* 51.—*a.* Gelatin.—42 colonies; three liquefying. Therefore, 428,400 colonies per c.c. of undiluted milk.

b. Phenol Gelatin.—33 colonies; none liquefying. Here only 21·5 per cent. of the microbes present in the milk seem to have been prevented from growing by the addition of phenol.

c. Potato Gelatin.—One small non-liquefying colony.

Infected milk diluted 1 *in* 51.—A seven days' old culture of typhoid on gelatin having been added to 250 c.c, of this milk and a corresponding series of plates made:—

a. Gelatin.—Plates were unsuccessful.

b. Phenol Gelatin.—296 colonies; none liquefying; many of typhoid bacillus on the surface.

c. Potato Gelatin.—No colonies.

At the end of two days similar plates were made from the infected milk, this time diluted with 100 and with 200 times its bulk of sterile water.

a. Gelatin.—All the plates yielded a large number of colonies, many of which caused liquefaction. The typhoid bacillus was not recovered from any of them.

b. Phenol Gelatin.—Many colonies; two typhoid bacillus colonies recovered.

c. Potato Gelatin.—299 colonies in the plates made from the less diluted milk, and considerably fewer in those made from the more diluted milk. No typhoid bacillus colonies were found.

Potato plates were also made by smearing on this medium a trace of the exuded serum from the milk at the end of a week. Two colonies of typhoid bacillus were found in one of these plates, none in the other.

Thus, in this instance, although few microbes were present in the original milk, and a large number of typhoid bacilli were added to it, the latter rapidly disappeared, or were swamped by increase of the other micro-organisms present, many of which were liquefying colonies. The typhoid bacillus was, however, found living at the end of a week, but its numbers must have very largely diminished.

(14.) Milk, a sample of which was obtained on March 23rd, 1897—

Uninfected milk diluted 1 *in* 51.—*a.* Gelatin.—Many colonies, several liquefying.

b. Phenol Gelatin.—53 colonies ; three of staphylococcus aureus.

c. Potato Gelatin.—No colonies.

Infected milk diluted 1 *in* 51.—The surface growth of a five days, old culture of typhoid on gelatin having been added to 250 c.c. of this milk, and similar plates made :—

a. Gelatin.—208 colonies ; three liquefying ; 16 of typhoid bacillus on the surface.

b. Phenol Gelatin.—124 colonies ; none liquefying ; 14 of typhoid on the surface. Here the addition of phenol appears to have stopped the growth of 40 per cent. of the microbes present in the milk.

c. Potato Gelatin.—28 minute colonies.

After the milk had been kept for 24 hours a similar series of plates was made, 100 c.m. of the milk being diluted with 10 c.c. of sterile water.

a. Gelatin.—Many colonies and much liquefaction.

b. Phenol Gelatin.—A large number of colonies ; three proved typhoid bacillus.

c. Potato Gelatin.—40 colonies, none proved typhoid bacillus.

From the same milk on the same day, diluted with 250 times its bulk of water, phenol gelatin plates were made, but only three colonies of the typhoid bacillus were found in them.

C.—*Sterilised Milk, to which Typhoid Bacillus and one and another additional Microbe were added.*

Typhoid Bacillus plus *Bacillus Lactis.*—A tube of sterile milk was inoculated with a trace of a typhoid bacillus culture. Of this 100 c.m. was taken and added to 5 c.c. of sterile water. Five c.m. were used in the preparation of each plate.

a. Gelatin.—271 colonies, including five of sarcina lutea. 43 colonies of typhoid bacillus grew on the surface of the gelatin.

From this same diluted material, kept in a glass dish covered by a glass plate, at the temperature of the room, gelatin and potato gelatin plates were made at the end of two days and yielded almost pure cultures of typhoid bacillus. Similar plates made from this material at the end of six days were also almost pure; they showed a very large number of colonies of the typhoid bacillus. Thus, in this fluid, the typhoid organism was capable of growth and multiplication.

The same sterile undiluted milk, after addition to it of typhoid bacillus, was inoculated with a trace of a culture of bacillus lactis. 100 c.m. of the mixture were then taken and added to 5 c.c. of sterile water. From this dilution plates were made, 5 c.m. being used for each plate.

Gelatin.—348 colonies, including three contaminations, developed. 28 of the colonies on the surface were typhoid bacillus.

This diluted material was kept in the same manner as was adopted for keeping the diluted milk inoculated with the typhoid bacillus only. At the end of two days gelatin and potato gelatin plates were made in the same manner as before.

Gelatin.—Many colonies of both organisms; 30 superficial colonies of typhoid bacillus.

Potato Gelatin.—30 colonies of typhoid bacillus, none of bacillus lactis were present when the plate was examined seven days afterwards.

At the end of six days potato gelatin plates were made from this dilute material by smearing. These plates showed, three days, afterwards, many colonies of both micro-organisms.

The infected sterile milk, from which the portions for dilution had been taken, was kept at 20° C., and became coagulated in two days. From the exuded serum thereof potato gelatin plates were made by smearing, and these yielded numerous colonies of the typhoid bacillus, but none of bacillus lactis.

These results indicate that the typhoid bacillus will live in the presence of the bacillus lactis for a week, but will not actually multiply under these conditions. The plates made from the diluted mixture containing both organisms yielded many fewer colonies than those made from the mixture on the day it was prepared.

Typhoid Bacillus plus *Oïdium Lactis*.—A tube of sterile milk was inoculated simultaneously with a trace in each instance of a culture of both micro-organisms.

Gelatin plates, made by smearing a trace of the mixture over the surface of the nutrient medium, yielded in three days many colonies of both organisms.

Gelatino plates made from this same milk, after it had been kept for 24 hours at 20° C., also yielded a number of colonies of both organisms. The number of the typhoid bacillus colonies had increased, while the number of the colonies of oïdium lactis was less than in the previous plates. Therefore, in sterile milk the typhoid bacillus grows more readily than the oïdium lactis.

Similar plates were made from the same milk at the end of three days, and a like result was arrived at; the typhoid organism considerably preponderated. Phenol gelatin plates gave similar results, but the growth of the colonies took place more slowly.

Gelatin and phenol gelatin plates prepared from the same milk at the end of six days gave like results.

Therefore the presence of the oïdium lactis in sterile milk does not interfere with the growth and multiplication of the typhoid bacillus.

Typhoid Bacillus plus *Yeast*.—Gelatin and phenol gelatin plates were made from sterile milk that had been inoculated with a trace, in each instance, of typhoid bacillus and of yeast. These plates were made on the day of inoculation, on the next day, the fourth day, and the seventh day.

The results obtained were analogous to those occurring in certain of the other investigations. Both micro-organisms increased in number, and neither appeared to be modified in its growth by the presence of the other.

App. B. No. 3.

On the Typhoid Bacillus in Milk; by Dr. Cautley.

General Summary.

The typhoid bacillus will live in milk under the conditions that ordinarily prevail in a household. When this bacillus has been artificially added in large amount to milk in the condition in which it commonly reaches the consumer, the presence of the microbe *in the living state* may be demonstrated after the milk thus treated has been kept several days.

There is no indication from the above investigations that this microbe is capable of multiplication under the conditions in question. Judging from the results obtained, it is very probable that the number present rapidly diminishes in milk which is kept.

It has been proved that the typhoid bacillus will live in sterile milk which is curdled by the addition of bacillus lactis.

It will also live in milk which has turned sour at the temperature of the room in which it is kept.

These latter results indicate that it is quite possible for the typhoid bacillus to exist in curd cheeses.

A few other results may be briefly referred to. Thus, the number of micro-organisms, of whatever variety, present in the milk as it reaches the consumer varies very considerably, mainly in accordance with the external temperature. The smallest number reached 142,800 per c.c. in a sample of milk examined in January, while the largest number was 8,119,200 per c.c. in milk examined during July.

The addition of phenol has a marked effect in preventing the growth of some of the micro-organisms commonly present in the milk. Its effect as regards the total number of micro-organisms of all varieties was, however, by no means a constant one, and the reduction shown in these experiments varied considerably, up to a maximum of 78·5 per cent.

Potato gelatin did not prove at all a reliable medium for this investigation. The results obtained from it were exceedingly irregular. It is, however, a useful medium to employ for discovering the typhoid bacillus, but not for counting the number of microbes present.

It is quite impossible to determine what proportion of the typhoid bacilli introduced into a given unsterilised milk will be found living at the end of a specified time. So many other micro-organisms are present in any such milk, and the rapidity of multiplication of these other micro-organisms depends so largely on the external temperature, that there is great difficulty in many cases in even discovering the typhoid bacillus. Probably the duration of its existence in milk is, to a great extent, determined by the character and number of the varieties of other micro-organisms already present.

No. 4.

REPORT on SPORE-BEARING ANAËROBIC BACILLI in the CONTENTS of the HUMAN INTESTINE, with special reference to their concern with ACUTE DIARRHŒA; by FREDERICK W. ANDREWES, M.D., F.R.C.P.

APP. B. No. 4.

On Spore-bearing Anaërobic Bacilli in their relation to Acute Diarrhœa; by Dr. F. W. Andrewes.

Origin of inquiry.

In the month of October 1895 I had to investigate a sudden outbreak of diarrhœa which occurred at St. Bartholomew's Hospital, London. The chief facts of this outbreak are related by Dr. Klein in the Report of the Medical Officer for 1895–96.* The malady was found by Dr. Klein to be associated with the presence, in the stools, of a peculiar and previously undescribed species of spore-bearing anaërobic bacillus of a highly pathogenic character, and which he named "Bacillus enteritidis sporogenes." There was reason for believing that the milk supply was responsible for this outbreak; the same organism was found in milk which had been supplied to the hospital.

In view of the little that is known as to the causation of acute diarrhœa, it seemed desirable to inquire into the occurrence of this and other spore-bearing anaërobic bacilli in the contents of the human intestine, particularly in cases of diarrhœa. So far as I can ascertain, no such inquiry has hitherto been undertaken; no one has yet attempted to study strictly anaërobic organisms in relation to diarrhœa.

Properties anaërobic organisms.

This field of inquiry appears a promising one. Micro-organisms which grow only in the absence of free oxygen obtain the oxygen which they require by splitting up organic compounds in the nutrient medium in which they grow. Therefore, speaking generally, they tend to produce more extensive chemical changes in the nutrient medium than do aërobic micro-organisms. So far as is known, the strictly anaërobic micro-organisms are all bacilli, and the great majority of them form spores. Some are highly virulent, *e.g.*, the bacilli of tetanus and of malignant œdema. We owe to Pasteur our earlier knowledge of the mode of life of anaërobic micro-organisms, and to Koch, Liborius, Lüderitz, Nicolaier, Kitasato, and others, our knowledge of the 20 or more species which have hitherto been described. Many are inhabitants of the soil, *e.g.*, Bacillus tetani and B. œdematis maligni; and Liborius and Lüderitz have described some eight non-pathogenic species from the same source. Others have been found in milk and in cheese. One of the great difficulties in sterilising milk depends upon the presence in it of spores of anaërobic bacteria which are in some cases able to withstand for a limited time the temperature of boiling water.

Methods of cultivation.

Anaërobic micro-organisms are necessarily more troublesome to cultivate artificially than those that are aërobic. In order to obtain growth upon the surface of nutrient media the cultivations must be carried out in an atmosphere devoid of free oxygen, *e.g.*, one of hydrogen, nitrogen, or carbon dioxide. Elaborate apparatus has been devised for this purpose, but the method suggested by Buchner of abstracting the oxygen from air by means of pyrogallic acid and caustic potash is the simplest and easiest, and I have had no difficulty in obtaining excellent results by its use. All that is necessary is to enclose the inoculated culture tubes in a larger tube provided with a closely fitting and well-greased rubber stopper. Into the bottom of the larger tube from $\frac{1}{4}$ to $\frac{1}{2}$ oz. of pyrogallic acid is first introduced, then, immediately before closing it, a few cubic centimetres of 10 per cent. caustic potash solution are poured in through a funnel. In a short time an atmosphere

* 25th Annual Report of the Local Government Board: Supplement containing Report of the Medical Officer for 1895–6. P.p. 197–204.

App. B. No. 4.

On Spore-bearing Anaërobic Bacilli in their relation to Acute Diarrhœa; by Dr. F. W. Andrewes.

practically free from oxygen is produced in the apparatus—one in which even very "strict anaërobes" will give evidence of good surface growth. Greater certainty may be attained by adding $\frac{1}{2}$ per cent. of sodium formate to the culture media employed. Even without this, however, I have obtained excellent plate cultures of various "strict anaërobes."

But anaërobic microbes may for practical purposes be grown quite well in the depth of solid culture media without the above precautions. If the culture tubes be filled with the nutrient medium (gelatin or agar-agar) to some two-thirds of their depth, and deep stab cultures be then made, very good growth will occur along the lower part of the stab, even in the case of the "strictest anaërobes," and additional security can be given by sealing the mouth of the tube with gutta percha. Under the latter conditions the gases evolved during the growth of the micro-organism may so far displace the air above the medium that growth extends up to the surface in the course of time. Otherwise the growth usually extends only to within $\frac{1}{2}$ or $\frac{2}{3}$ of an inch of the surface. To permit the anaërobic micro-organism to supply itself with oxygen it is best to add 2 per cent. of grape sugar to the culture medium, as this substance is easily decomposed. Many anaërobic microbes liberate considerable quantities of gas (hydrogen, carbon dioxide, marsh gas, &c.) as the result of the chemical changes they induce in the medium in which they grow, and such gas may even force out the cotton wool plug from the mouth of the test tube.

Scope of present inquiry.

It was determined to investigate only the "strict" or "obligatory" anaërobic microbes present in fæces. Many aërobic micro-organisms are capable of nourishing themselves after the manner of anaërobes when circumstances compel them to do so. But of such I took little notice, because the unworked field which it was desired to investigate did not lie here. Further, only those which formed spores could be studied satisfactorily, because the presence of highly resistant spores formed the only practical method by which they could be separated from the myriads of other micro-organisms present in the intestinal contents. Exposure to a temperature of 80° C. for 10 minutes almost always suffices to kill micro-organisms which form no spores; I have met with few exceptions.

Methods adopted.

The methods adopted were those suggested to me by Dr. Klein, and which he had found the most satisfactory in isolating the "Bacillus enteritidis sporogenes" from fæcal material. It was for this organism that I specially desired to search.

Having obtained stools from a case of diarrhœa, they were first examined microscopically to ascertain whether spores could be recognised. This, however, was rarely the case. Small quantities of stool (one to three platinum loops-full) were then inoculated into deep grape-sugar gelatine culture tubes, which were then at once exposed in a water bath to a temperature of 78°–80° C. for 10 minutes. By this procedure, practically spores alone, of such microbes as happened to be present, were left free to germinate. These might, of course, be spores of aërobic micro-organisms, but further subculture enabled such to be recognised and rejected. As a matter of fact, however, these were rarely found—a fact which has surprised me considering the commonness in stools of such micro-organisms as B. mesentericus vulgatus or its varieties. Rarely did any non-spore-bearing organisms survive; though this was occasionally the case. Bacillus coli communis was almost invariably killed; it may, indeed, withstand a temperature of 80° C. for more than 10 minutes when fæcal material "en masse" is so heated, but in the course of 40 or 50 experiments performed as above, with a small amount of fæcal material well distributed in the gelatin, I only found it survive once or twice, and then only in isolated colonies. A staphylococcus survived once, and a liquefying aërobic micro-organism once.

App. B. No. 4.

On Spore-bearing Anaërobic Bacilli in their relation to Acute Diarrhœa; by Dr. F. W. Andrewes.

The inoculated culture media, having been thus treated, were allowed to solidify, and the mouths of the test tubes containing them hermetically sealed with gutta percha tissue. They were then incubated at 20° C. The colonies which arose in the deeper parts of the nutrient medium became conspicuous, when present, in two or three days, or at most in a week. Subcultures (either stab cultures or shake cultures) were made from them in deep grape-sugar gelatin tubes. This was done in two ways. Usually it was not difficult to push down a freshly drawn and sterile pipette through the gelatin, and so suck up from the depth some of a liquefying colony (most of the species obtained liquefied the gelatin), and transfer it to a fresh culture tube. At other times it was found best to break the tube, cautiously, with a hammer by a light blow, to incise the gelatin with a hot sterile platinum wire, and so attain direct access to individual colonies for purposes of subculture. Having obtained pure cultures of the micro-organisms present, not always an easy matter, their properties and characters were then carefully studied. They were grown in various media, by various methods, and their pathogenic properties were tested.

Account of cases investigated.

I will now describe the diarrhœa cases investigated, and the results obtained in the order in which they came under notice.

Case I.—A man who had been admitted to St. Bartholomew's Hospital in the month of February 1896 for abdominal pain, supposed to be due to enteritis, became constipated, and was given a dose of castor oil. From the resulting loose brown stool I isolated, by the above methods, numerous colonies of a liquefying, gas-forming, slowly-growing anaërobic bacillus, which corresponded in most of its characters with B. enteritidis sporogenes, of which it may be regarded as a variety, though in this case it was not pathogenic. I append a full description of its characters in the later part of this report. I may say here that I found it the commonest of all anaërobic spore-bearing bacilli in the cases investigated, and there is reason to suppose that it is the cause of some cases of diarrhœa. I found also in the cultures from this case a number of colonies of tough, opaque, white growth, which consisted of peculiar fusiform bodies surrounded by granular material. They would not grow in subcultures, and I am unable to say what they were.

Case II.—A girl, suffering from gastric ulcer, who was an in-patient in St. Bartholomew's Hospital in February 1896, habitually passed loose motions. From one of these, numerous colonies of a liquefying anaërobic bacillus were isolated, which in most respects coincided with the B. enteritidis sporogenes of Klein. It differed merely in its slower rate of liquefaction and in its feeble pathogenic powers.

Case III.—A patient suffering from catarrhal jaundice passed, as the result of an enema, a loose porridge-like stool of offensive odour. Anaërobic cultures from this stool yielded numerous colonies of the variety of B. enteritidis found in Case I.

Case IV.—A man, aged 38, otherwise in good health, was attacked on February 27th, 1896, with acute diarrhœa accompanied by griping pains. The stools were liquid and dark brown in colour. Anaërobic cultures from the stools yielded two organisms, both of which were represented by numerous colonies, and which were identical with the varieties of B. enteritidis sporogenes found in Cases I. and II.

Case V.—In July 1896 an infant of five months, which was being carefully fed in hospital on "humanised milk" supplied by the Aylesbury Dairy Company was suddenly attacked by enteritis and passed greenish-

yellow stools containing undigested curd and pinkish mucus. The attack was accompanied by fever. The stools were teeming with micro-organisms. Cultures heated, as above, to 80° C. for 10 minutes yielded however no growth of any description.

Case VI.—On July 13th, 1896, a man of 54, who had partaken of gooseberry and rhubarb tart, was seized with very severe diarrhœa, accompanied by vomiting and abdominal pain, cramps in the legs, collapse, and choleraic symptoms generally. He was admitted to the hospital on July 17th in a very collapsed condition, the diarrhœa still continuing. The stools were watery and of a pale whitish brown colour, separating on standing into a clear fluid and a turbid sediment which contained enormous numbers of leucocytes. Cultures made from one of the stools yielded, after heating to 80° C. for 10 minutes, no anaërobic colonies at all, and only one liquefying aërobic colony.

Case VII.—A hospital nurse, otherwise in good health, had on the night of July 21st, 1896, a moderately sharp attack of diarrhœa, with some abdominal pain and vomiting once. No collapse or cramps. The attack subsided in 12 hours without treatment. One of the stools passed at the end of the attack was examined and showed many long feathery bundles of fat crystals. Bacilli were numerous, but no definite spores could be seen. Two anaërobic culture tubes were inoculated and each yielded three or four colonies of typical B. enteritidis sporogenes, corresponding in all respects with the organism described by Dr. Klein, except that its pathogenic powers were much less pronounced.*

Case VIII.—A night scavenger, aged 49, was attacked on September 10th, 1896, with diarrhœa, which in the course of 24 hours grew worse and became associated with vomiting and serve abdominal pain. He was admitted to the hospital in a state of extreme collapse, with severe cramps and continuous discharge from the bowel of watery, nearly colourless, material containing mucus. I had no opportunity of obtaining material from this case till the severity of the attack had passed off, but on September 15th the man passed a semi-solid, pasty, greyish stool, from which cultures were made. These, having been heated to 80° C. for 10 minutes, yielded no anaërobic organisms, but several colonies of cocci and one of B. coli communis.

Case IX.—A child, aged two years and four months, was attacked by diarrhœa on September 11th, 1896. The stools were watery and offensive and contained much undigested curd. The child was slightly febrile and was ill and wasted. From a stool passed on September 14th a culture was made, and two further cultures from one passed on the 15th. These all yielded B. enteritidis sporogenes, which was abundantly present in the stool passed on the 14th (in which it was associated with several aërobic organisms which resisted a temperature of 80° C.); in the stool passed on the 15th this bacillus was present much more scantily, but in pure culture.

Case X.—A child of eight months, fed on Nestle's milk, was attacked on September 7th, 1896, with diarrhœa and vomiting. The stools were at first greenish—later nearly colourless, watery, offensive, and very frequent. On the 14th the child was admitted to hospital, much collapsed—the diarrhœa persisting. On the 15th cultures were made from a

* I should add that the animal experiments in this case were made by inoculation with a liquefied gelatin culture. The same applies to the organism found in Cases II. and IV. F.W.A.

stool which contained much curd. No anaërobic colonies grew, nor did any micro-organisms at all survive exposure to the temperature of 80° C.

Case XI.—A child of three years suffered from diarrhœa and vomiting from September 9th to September 15th, 1896. It was admitted to hospital for nephritis, possibly of scarlatinal origin, as it was peeling. On admission the diarrhœa had nearly ceased, but one small light brown, offensive, liquid stool was passed just after admission, and from this two cultures were made. So many colonies developed that further cultures were made from the same stool much diluted with sterile salt solution. Large numbers of colonies of B. enteritidis sporogenes developed; no other anaërobe was present.

Case XII.—A Danish sailor, who had landed from his ship, was seized on August 8th, 1896, at Plumstead, with choleraic symptoms, and died in 12 hours from the onset. The case was not one of Asiatic cholera; some of the intestinal contents were examined by Dr. Klein, but no cholera vibrios were found. Anaërobic cultures were made by Mr. M. Gordon from flakes in the intestinal contents, and he found the preponderating organism to be an anaërobic bacillus which liquefied the gelatine and formed large quantities of gas. He kindly handed the cultures to me in September. The micro-organism proved different to any of those hitherto found by me, and I cannot positively identify it with any described species, though it may be the Bacillus muscoides of Liborius, or the Bacillus solidus of Lüderitz. I refer to it again later.

Case XIII.—In August 1896, a man of 20 was attacked by severe diarrhœa and abdominal pain after eating a haddock which was not quite fresh. He was admitted to the hospital ill, but not much collapsed, and with a temperature of over 104° F. The stools were very frequent and bloody, and there was tenderness over the colon. Mr. M. Gordon made cultures from one of the bloody stools, and found an anaërobic bacillus present in large numbers. He kindly handed me the cultures in September, and I found the bacillus to be B. enteritidis sporogenes.

Case XIV.—A man landed at Gravesend in October 1896, having come from Alexandria on a steamship. He had suffered from diarrhœa on the whole voyage home, and a specimen of his stools was sent to Dr. Klein on suspicion of cholera. No cholera vibrios were found. An anaërobic culture yielded severel colonies of a peculiar anaërobic bacillus; many of the colonies were highly branching. It grew with difficulty in subculture and did not again assume the branching form. It formed no gas and did not liquefy the gelatine. Amongst described species it most closely approached to the Bacillus polypiformis of Liborius; but I cannot positively refer it to that species.

Case XV.—A woman, 32 years of age, was seized on December 26th, 1896, with severe vomiting and diarrhœa. She was admitted next day to hospital much collapsed, writhing with colic, with severe cramps, and an almost imperceptible pulse. The temperature was subnormal. The stools were colourless, like rice-water. Of two anaërobic cultures made from a stool, one yielded no growth; the other, two colonies of B. enteritidis sporogenes.

Case XVI.—A hospital nurse had a short but sharp attack of ordinary diarrhœa in February 1897, lasting two days, and without constitutional symptoms. Anaërobic cultures made from one of the stools yielded no growth of any kind.

Case XVII.—A medical man, having "caught a chill" in March 1897, was attacked by diarrhœa lasting a week or ten days. The stools were bright yellow and voluminous, and apparently in a condition of fermentation. Cultures from one of the stools yielded no anaërobic microbes, but one of the tubes developed three colonies of an aërobic spore-bearing bacillus closely allied to B. mesentericus, but liquefying more slowly.

Case XVIII.—A hospital nurse had a smart attack of ordinary diarrhœa, with a little vomiting, on March 30th and 31st, 1897. It yielded readily to treatment. Anaërobic cultures from a stool yielded one or two colonies of a bacillus resembling B. enteritidis sporogenes, and one branching colony resembling B. muscoides.

Case XIX.—A boy of six had suffered all his life from fatty diarrhœa, his stools containing large quantities of fat resembling butter in its composition. A specimen of one of the stools which came into my hands recently was examined for spore-bearing anaërobes in the usual way. The cultures yielded one colony of an organism similar to B. enteritidis sporogenes and several highly branching colonies, resembling B. muscoides.

Case XX.—A man of 32 was seized with acute choleraic diarrhœa at midnight on July 31, 1897, and was admitted to hospital two hours later much collapsed. The symptoms were typically choleraic—prostration, cyanosis, and severe cramps—but Asiatic cholera was excluded by bacteriogical examination of the stools. He died 58 hours from the onset. The autopsy showed merely congestion of the intestine. Ordinary poisons were excluded by chemical examination of the contents of the stomach. Anaërobic cultures in milk and gelatin were made from the intestinal contents, and heated to 80° C for 10 to 15 minutes. One of the milk tubes was densely coagulated in 48 hours, and a cubic centimetre of the whey was injected subcutaneously into a guinea-pig, which was found dying 24 hours later, with intense hæmorrhagic œdema and necrosis spreading from the seat of inoculation. Subcultures from the œdema fluid, as well as the original cultures in sugar gelatin from the intestinal contents showed one organism only, corresponding in every respect with B. enteritidis sporogenes. A second guinea-pig inoculated by Mr. Gordon, with the œdema fluid from the first, died in the same way and with the same appearances.

Conclusions.—Although the number of cases here reported is not a very large one, yet the list contains examples of many different forms of diarrhœa of every degree of severity, and one or two cases in which diarrhœa can scarcely be said to have been present. I investigated all cases as they chanced to present themselves, and the series may be taken as an ordinary one. It will be seen that the only anaërobic microbe which I found at all commonly was B. enteritidis sporogenes in its different varieties. For some time I was inclined to regard some of the varieties as harmless saprophytes, having at first employed liquefied gelatin cultures for inoculation into animals and as at least one variety liquefies gelatin slowly, it is probable that some such cultures had lost their virulence. That the microbes may be pathogenic, and virulently so, is shown by the results of Case XX.: the effects produced in this instance upon guinea pigs were identical with those produced by typical B. enteritidis sporogenes.

Whether the bacillus in question is actually a cause of acute diarrhœa is not so far positively established, but there seems a distinct probability that such is the case, and the field of inquiry is a promising one.

It must be borne in mind, however, that in some of the cases I only obtained material after the acuteness of the disease had passed, and also that the methods adopted would have failed to detect this microbe except in the sporing condition. That in many cases I did not succeed in demonstrating the presence of anaërobes in cases of acute diarrhœa, by no means proves their absence in a non-sporing form.

The other two anaërobic microbes of interest which were met with were associated with Cases XII. and XIV.—in each instance in a person who had come from abroad. It is, of course, impossible to draw any conclusions from single cases, but the fair correspondence which existed between the micro-organisms obtained and certain known non-pathogenic anaërobes from the soil makes it unlikely that the particular bacilli had any causal relation with the diarrhœa in the present instance. The same is true with regard to the micro-organism resembling B. muscoides.

Biological characters.

In distinguishing between species of micro-organisms, it is often a matter of great difficulty to know what characters are of importance and what characters are so variable as to be of little value in classification. This is perhaps specially the case with anaërobic micro-organisms. I am inclined to attach little importance to motility, as many anaërobes well-provided with flagella show very little or no motility when examined in the ordinary way. The presence of flagella on the contrary is a valuable character in classification, as is the readiness and abundance with which spores are formed. Liquefaction of gelatin, again, is a character which may often mislead; in different subcultures of the same organism very wide variations may exist in the rapidity of liquefaction, and the character may actually disappear on repeated subculture, as in the case of one microbe in the present inquiry. The power of gas formation is a more constant character, but is liable to show variations. The form of the individual colonies, or of the growth as a whole, must not be relied upon too implicitly; a species which at one time gives rise to beautiful branching moss-like growth in the depth of the gelatin may at another time grow only in solid rounded colonies. In one case of this kind it took many weeks of tedious work to convince me that I was dealing with one species of bacillus and not with two. Upon chemical characters much more reliance may be placed; thus I have found one of the most reliable means of distinguishing between some species of anaërobes to be the character of the changes produced when they are grown anaërobically in milk. Lastly, pathogenesis may not always prove a safe guide, inasmuch as it may very readily be lost when a species is cultivated for long in the laboratory. Thus, Dr. Klein's original cultures of B. enteritidis sporogenes, at first highly virulent, lost in a short time nearly all their pathogenic powers. And I was unable to produce a fatal result in guinea-pigs with this species, even when I first isolated it from Case VII. in this series. In the present case it is a matter of considerable difficulty to decide whether the different organisms, which I have described above as varieties of B. enteritidis sporogenes, should or should not have specific value assigned to them. The varieties of diarrhœa are numerous, and it may well be that more than one species of anaërobe is concerned in their production. It seems, however, expedient at present to avoid the creation of specific distinctions, which may subsequently have to be discarded. I therefore abstain from doing so, and treat the different organisms as mere varieties of B. enteritidis sporogenes. I may say, nevertheless that I think it possible that we are dealing with two organisms, each of which may prove to have specific value when further investigated, differing in particular in their action on milk. I append a description of the variety of bacillus which I have found most frequently present in the above

App. B. No. 4.

On Spore-bearing Anaërobic Bacilli in their relation to Acute Diarrhœa; by Dr. F. W. Andrewes.

Description of individual species.

investigations, and which differs from the original type of B. enteritidis sporogenes, described by Dr. Klein, in one or two particulars.

Bacillus Enteritidis Sporogenes: Variety.

Long straight bacilli, often forming long jointed threads.

Measurements: Thickness, ·8 μ; average length, 4 to 8 μ, but very variable; threads of 20 to 30 μ may be seen.

Motility: No spontaneous movements seen. No flagella demonstrable.

Spore formation: Very scanty and difficult to obtain in cultures. But it must occur, since, in all cases, the organism was obtained from material which had been heated to 80° C. for 10 minutes.

A "strict anaërobe."

Surface growth on formate agar-agar in an oxygen-free atmosphere; in one to two days there is a delicate semi-transparent greyish, growth of confluent colonies, with smooth or wavy edges, which later show fern-like and dentate outgrowths.

Growth in grape-sugar gelatin: Stab cultures show scanty dotted growth in 24 hours, extending to within $\frac{3}{4}$ inch from the surface. In 48 hours the growth is confluent, white, opaque, and somewhat filamentous in texture. Growth proceeds slowly, and liquefaction appears from the second to the fourth day. The gelatin is usually only partially liquefied even after several weeks. Gas formation does not appear, as a rule, till the fourth or fifth day. Later, the gas extends up the needle track, and commonly bursts laterally through the gelatin to the side of the tube, about half an inch from the surface, and so up to the surface. Along this track the growth rapidly passes to the surface, where it appears as a very viscid, greyish material, full of gas bubbles. Old cultures show varying liquefaction of the gelatin, which after a time becomes clear with a dense white deposit of bacilli. The latter remain unaltered for a long time, and do not rapidly break up. Spores are, however, hardly ever seen in them. Cultures retain their vitality for six weeks or more. Shake cultures in grape-sugar gelatin show similar appearances, but liquefy rather less slowly. The earliest colonies are visible in two days, and they become somewhat irregular in shape.

Growth in milk: Milk cultures incubated at 37° C., in an atmosphere free from oxygen, coagulate energetically in from one to four days, usually in two. A firm white curd separates from a clear whey and undergoes no further breaking up or digestion. A strongly acid reaction is produced, and the cultures have a faint sour smell, sometimes but not always distinctly like butyric acid. Tested volumetrically the amount of acid produced is not large.

Pathogenesis: Subcutaneous inoculation of guinea-pigs with recent milk cultures produces in some cases intense spreading hæmorrhagic œdema and necrosis, and death in 24 hours. In other cases it is not pathogenic.

The variety of B. enteritidis sporogenes which I obtained from Cases II. and IV., resembled the typical micro-organism described by Klein in its measurements and in the possession of flagella. In its growth in sugar gelatin it resembled that microbe closely, except that it was distinctly slower in growth; liquefaction occurred at about half the rate which characterised the type, and this relative slowness of growth was a constant phenomenon. The changes produced by it when grown anaërobically in milk were coagulation, with subsequent peptonisation of the curd, and the development of an amphoteric reaction, with a foul smell. In pathogenesis it resembled a very feebly virulent B. enteritidis, producing, when injected subcutaneously into guinea-pigs, some swelling and infiltration of the subcutaneous tissues, which cleared up in a few days. Spore formation was abundant.

No. 5.

PRELIMINARY REPORT on the MICROBES associated with SCARLATINA; by Dr. KLEIN, F.R.S.

Convalescents from scarlatina, who in all respects—general health and complete disappearance of all desquamation and throat symptoms—have been deemed fit to leave hospital and to mix with healthy persons, have nevertheless, now and again, after return to their homes been known to operate as centres of infection.

The question therefore has arisen: On what condition or conditions does the sustained or recurring infectiousness of such persons, "return cases" as they are termed, depend? In other words, with what material pertaining to, secreted or excreted by, these persons is the contagium of scarlatina associated.

In former reports, 1885–8, I have adduced a considerable amount of evidence that a particular streptococcus which I designated the *streptococcus scarlatinæ* is the contagium of the disease scarlatina. My conclusions, in this sense, were, by subsequent observers and writers on the subject, criticised adversely. But, judging from their published criticisms, not one of these persons seems to have followed the lines of the experimental inquiry on which my conclusions were based, or, indeed, even to have read my full reports on the subject. They appear to have contented themselves with the fragmentary and short notices of my work that had appeared in one and another journal. At the present time the contagium of scarlatina is considered by the majority of bacteriologists as still unidentified. For instance, several workers (Raskine, Fraenkel, Kurth, and others) accept the streptococcus which they have isolated from the throat or the kidney in scarlatina as concerned with a secondary though by no means indifferent infection. The most recent writer, Kurth (Arbeiten aus d. Kais. Gesundt-heitsamte, VII.) describes a streptococcus from the sore throat of scarlatina as recognisable by its peculiar growth in broth, since it forms therein agglomerations of streptococcus chains matted together; and he names it "streptococcus conglomeratus." Had Kurth read my description of the streptococcus scarlatinæ,* he would have found that the habit of forming conglomerations in the deeper parts of broth culture was one of the characters which I assigned to the streptococcus scarlatinæ. Also, he would have found that some of the morphological appearances—here and there a larger globular element in the course or at the end of the chains of smaller cocci — which he himself insists on as distinguishing his streptococcus, were mentioned by me as pertaining to the streptococcus scarlatinæ, as indeed they pertain to other streptococci.

Kurth (l.c.) isolated his streptococcus from the throat only, and in this sense his observation of the microbe has been less extensive than my own. Ten years ago* I isolated this streptococcus from the blood of scarlatina patients during the earlier febrile stage, as also in one case after the death of the person attacked. In all I met with it in the blood in five cases out of the eleven that I examined in this respect. This being so, and in the absence of any tangible evidence discrediting the streptococcus scarlatinæ as the essential cause of scarlatina, I have had in the present investigation necessarily to give particular attention to this microbe as possibly of important concern in my inquiry.

I am quite well aware that various observers, as for instance, L. Pfeiffer, have asserted that coccidia are the cause of all eruptive

* Report of the Medical Officer, 1886–1887, pp. 369 to 374.

App. B. No. 5.

On Microbes in Scarlatina; by Dr. Klein.

diseases as also of cancer; but I do not think that Pfeiffer's statements, based as they are on extremely cursory histological examination, can claim any serious weight, moreover, I do not know that any serious weight is attributed to them by other bacteriologists. At the present time indeed, another microbic form, said to belong to the torulæ or blastomycetes, seems to threaten to supplant the coccidia in this connexion; but whether or not the pathogenicity of this torula in relation to acute exanthemata is to be accepted, must for the present, owing to the extremely slender and fragmentary character of the evidence, remain matter of doubt.

However this may be, it was necessary first of all, in commencing study of the problem submitted to me, to investigate the character of the microbes that occur in the various samples of material, from persons affected with scarlatina, that could be thought of as likely to harbour the contagium; and in this respect the desquamating cuticule and the urine of convalescents, as well as the exudation of the diseased throat in the acute and in the later stages of the disease appeared to require special attention. The amount of work, however, involved in the isolation and identification of the microbes occurring in the desquamating cuticle and in the urine of scarlatina convalescents, and the sorting out of those occurring in the inflamed throat in the acute stages of the disease, has been so heavy that, notwithstanding able and abundant help by Mr. Mervyn Gordon, identification of the microbes in the throat and nasal discharges during the convalescent stage, has not yet been undertaken.

I.—*Bacterioscopic Examination of the Desquamating Cuticle in Scarlatina Convalescents.*

This examination comprised eight cases; five of which were patients in the London Fever Hospital, three patients in private practice. In all of the eight desquamation was very pronounced. The cuticule was taken from the leg or from the hand, or from both, between the ninth and twenty-first days of the illness.

The following microbes were isolated:—

(1.) The commonest microbe was a sporing motile aërobic bacillus which corresponds in its morphology and general cultural characters to bacillus mesentericus. This microbe was not however in all cases exactly the same. Samples of the bacillus from different cases differed from one another in the rate at which the microbe liquefied gelatine, and in the rapidity with which it formed a wrinkled thick pellicle on the surface of broth incubated at 37° C. Nevertheless in size, in tendency to form filaments, as regards mobility and flagella, as regards formation of oval spores, and as to general behaviour in plate and in other culture on gelatine and agar, the bacilli of all the samples appeared closely related to one another and to the ubiquitous bacillus mesentericus. The so-called sporing bacillus scarlatinæ isolated from scarlatinal scurf and described by Edington,* and the bacillus described by me as the "scurf bacillus" of the cuticle of normal skin, belong to this same group.

(2.) In two of the eight cases a minute bacillus was isolated, which by its size and general morphology corresponds to the bacillus xerosis, a microbe not uncommon in the cuticle of normal and of diseased skin.

(3.) In four out of the eight cases a non-liquefying variety of staphylococcus albus was obtained.

* British Medical Journal, June 1887.

(4.) In two out of the eight cases a slowly liquefying white coccus.

(5.) In two cases the ordinary sarcina.

In no case was a streptococcus identified.

II.—*Bacterioscopic Examination of the Urine in the desquamating Stage.*

The urine of three of the above patients, boys, was strictly scrutinised. After cleansing the penis, the patient was asked to void urine, and the later portion discharged by him was received into a small sterile bottle and submitted to examination.

(1.) In one case (14th day of illness) the urine contained very few microbes; a whole cubic centimetre yielded in a plate culture two colonies only. These proved to be closely related to, if not identical with, the micrococcus ureæ.

(2.) In the second case (16th day of illness) the urine also contained only a small number of microbes; 0·25 of a cubic centimetre yielded in a surface agar plate but four colonies. Of these, one corresponded to staphylococcus albus liquescens; the other three were bacilli which in subculture proved bacillus coli. Two of them were, as to size and flagella, as to growth in plates, as to gas production in gelatine shake culture, as to acid production and curdling of milk, and as to indol formation in broth culture, typical bacillus coli. The third bacillus differed from the typical bacillus coli solely in the fact that it did not form gas bubbles in gelatine shake culture.

(3.) In the third case, 0·25 of a cubic centimetre of the urine yielded in plate culture several (5) colonies of proteus vulgaris, and two of a non-liquefying white staphylococcus.

In no sample of urine was a streptococcus discovered.

III.—*Bacterioscopic Examination of the Throat in the Acute Stage of Scarlatina.*

From six cases of scarlatina tested during the first week of illness, material taken from the swollen tonsils and examined by agar surface plates yielded in all instances streptococci and staphylococci. Amongst the former the streptococcus which I have termed the streptococcus scarlatinæ (streptococcus conglomeratus of Kurth) was isolated readily and in many colonies.

Other streptococci and staphylococci were obtained from these throats of early scarlatina, as also from some normal throats and in some sore throats not scarlatinal. In respect of microbes of this class not peculiar to scarlatina, the tonsils were examined of 17 normal persons, and, in addition, the tonsils of 20 cases of mild sore throat in which congestion of the tonsils, fauces and neighbouring mucous membrane was a common symptom.

(A.) *Seventeen normal throats.*—(*a.*) Staphylococcus albus was found in every case plentifully; staphylococcus albus liquescens in nine of the 17 cases, and staphylococcus citreus in five. *Staphylococcus aureus was not met with in a single normal throat.*

(*b.*) Sarcinæ, alba and lutea, were found in six cases; moulds: penicillium glaucum and aspergillus niger, in two; a red torula in one case.

(*c.*) Streptococci were found in 14 cases, mostly streptococcus pyogenes and streptococcus brevis of Lingelheim. Amongst nondescript streptococci was one liquefying gelatine.

(*d.*) Bacillus coli was found in one case, and bacillus mesentericus in two; bacillus buccalis minutus of Vignal in one case.

App. B. No. 5.

On Microbes in Scarlatina; by Dr. Klein.

(*e.*) A motley of nondescript species of bacilli of various sizes; some liquefying and mobile, others non-mobile and non-liquefying; some forming distinct leptothrix, others not doing this.

(B.) *Twenty cases of mere sore throat.*—(*a.*) Staphylococci were abundant in all cases, and of the same characters, viz., albus, as in the normal throats. In addition, *staphylococcus aureus was present in five of the* 20 *cases.*

(*b.*) Streptococci were present in 16 cases. They were greatly in excess of other cocci in five cases; they were altogether absent in four cases, including three cases of coryza.

(*c.*) Bacillus buccalis minutus was met with in two cases.

(*d.*) The Pseudo-diphtheria bacillus of Hoffmann and Löffler: that is to say, a bacillus morphologically and culturally identical with the diphtheria bacillus but having no pathogenic action on guinea-pigs. This was met with *in the throat of three cases of coryza, in which no streptococci could be demonstrated.* In one of these cases of coryza the pseudo-diphtheria bacillus was present on the tonsils in almost pure culture, plate surface-cultures on agar yielding crowds of colonies of this bacillus, with very few other colonies. The great preponderance of this species in coryza was obvious also in stained cover glass specimens made with the matter taken from the tonsils. As already mentioned, cultures of this microbe proved quite harmless when injected into the subcutaneous tissue of the guinea-pig, and in this way it was differentiated from the true diphtheria bacillus.

No. 6.

App. B. No. 6.

On the Microbes of Vaccinia and Variola; by Dr. Klein.

Report on Further Observations of the Microbes of Vaccinia and Variola; by Dr. Klein, F.R.S.

In a paper in these Reports entitled "Observations on Micro-organisms "in Lymph of Vaccinia and Variola."* I have pointed out the occurrence in vaccine lymph from the calf, as also in the lymph of small-pox vesicles, of peculiar minute bacilli. These bacilli, for reasons that I have there stated, deserve, in my view, to be thought of as the essential elements of the one and the other malady.

Dr. Copeman, working independently on the same subject, has confirmed my observations. In addition, he has succeeded in growing, alike from the material of vaccinia and variola, and with the contents of the hen's egg as a cultivating medium, what would seem to be these same bacilli. And, further, Dr. Copeman appears to have obtained, on inserting into successive calves material from a particular egg inoculated after his method with powdered small-pox crust, a lymph which, as regards its local effect on the calf and on the human subject, is not distinguishable from current vaccine lymph.†

At the request of the Board I made test of the contents of two series of eggs furnished me by Dr. Copeman after inoculation with vaccine and variolous material respectively by his method; and I next proceeded to myself make experiments with the hen's egg as a culture medium for the microbes of vaccinia and variola. Later I made observations of solid media as cultivating ground for the microbe of variola.

I.—*Inoculated Eggs furnished by Dr Copeman.*

On 22nd June 1895 I received from Dr. Copeman a number of eggs which, after inoculation by him on 20th May, had been incubated at 37° C. At once, on receiving them, they were placed by me again to an incubator set at the same temperature. These eggs were labelled in the following effect:—

Eggs VI., VII., and VIII. had been inoculated with crusts of variola after two weeks storage of the latter in glycerine.

[*Egg* VIII. had been opened and resealed 13th June.]

Eggs IX. and X. had been inoculated with glycerinated calf lymph which had been "prepared" on 6th May.

[*Egg* IX. had been opened and resealed 13th June.]

Egg XI. had served as a control experiment; it had not been inoculated with vaccinia or with variolous material.

Egg XII. had been inoculated, in subculture, with material from a previous egg, No. V., which had been kept two weeks in a sealed pipette. Egg No. V. had been nearly three months earlier inoculated by Dr. Copeman with crust of variola which had been rubbed up with a small quantity of sterile salt solution.

[*Egg* No. V. was also sent to me by Dr. Copeman, with a note to the effect that on opening it 20th May, for the purpose of obtaining from it material for inoculation of *Egg* No XII, he had found it to contain a small bacillus in pure culture. The egg in question

* Report of Medical Officer of Local Government Board, 1892–93, pp. 395–400.

† Paper read in the section of Pathology. British Medical Association meeting, July–August, 1895.

App. B. No. 6.

On the Microbes of Vaccinia and Variola; by Dr. Klein.

had been resealed. On subsequent examination bacterioscopically I found it to contain numerous staphylococci and a few small bacilli. Some of the contents of this egg inoculated by me into a calf failed in producing any local effect; subculture made in egg of the above yielded growth of staphylococci only.]

On examination of the several series of eggs "prepared" by Dr. Copeman on 20th May, I obtained the following results:—

Series 1; *Variola*.—Eggs VI., VII., and VIII. were tested by me on several separate dates—26th June, 1st July, and 15th July. On each occasion a small hole was drilled in each egg, and a small amount of its contents withdrawn, the egg being immediately resealed. The egg contents thus obtained were in each instance examined as coverglass specimens, and were tested further in subculture—within other eggs, on ordinary agar, and in glycerine agar.

As a result, in no single instance was a microbe of any sort discovered in the cover glass specimens. No growth whatever appeared on the agar and glycerine agar subcultures that were established with the egg contents. Egg subcultures, too, entirely failed.

Series 2; *Vaccinia*.—Egg IX. was opened on 1st July. Coverglass specimens of its contents revealed cocci and bacilli in fair numbers. Subculture showed these microbes to be staphylococcus aureus and bacillus mesentericus vulgatus. Egg X. was also opened 1st July. It contained numerous cocci, but no bacilli. On subculture the micro-organisms present were found to be staphylococcus albus and staphylococcus aureus.

Series 3; *Variola*.—Egg XII. was opened 24th June. On the surface of its contents was a thick creamy pellicle, which was drying up; the space beneath it was empty. Coverglass specimens of the pellicle revealed numerous cocci and a few short thin bacilli. On subculture of the pellicle on agar and in sugar-gelatine, cocci alone made their appearance. These rapidly liquified the medium. Cutaneous inoculation of a calf with the matter of the pellicle gave negative result.

Having failed in getting positive results as regarded the eggs furnished me by Dr. Copeman, I next proceeded to repeat Dr. Copeman's experiments in their entirety.

II.—*Experiments of my own in the Inoculation of Eggs with the Material of Vaccine and of Variola.*

Eggs inoculated with Vaccine Lymph.—I inoculated after Dr. Copeman's method two series of eggs; the one series with calf lymph that had been kept for a month in undiluted glycerine, the other series with calf lymph preserved for two weeks in a mixture of equal parts of glycerine and beef broth. Both series of eggs, after inoculation, were incubated at 37° C. for four weeks. At the end of this period cover glass specimens of their contents showed cocci only, and in agar-culture colonies of staphylococcus aureus alone made their appearance.

Eggs inoculated with Variolous Matter.—Again two series of eggs were dealt with.

Series 1.—Small-pox crusts, from cases of confluent small-pox in the Gloucester epidemic, were mashed up with sterile salt solution in a mortar; both pestle and mortar were previously sterilised. Nine eggs were employed in this series. Each egg of the series was then inoculated, by means of a freshly drawn capillary pipette and through a small hole in the shell made with a thick sterilised needle, with several drops of the above turbid salt emulsion of small-pox crusts. The shell of

the egg previous to its inoculation had been well washed with perchloride of mercury solution and well dried again with sterile cotton wool. After inoculation, the hole in the egg was immediately closed with a drop of ordinary sealing-wax. They were incubated at 37° C. for periods ranging from three weeks to three months before their contents were submitted to test. When they came to be examined, certain of them yielded staphylococcus aureus in pure culture; others yielded a spore-bearing bacillus not distinguishable from bacillus mesentericus; while others again proved altogether sterile.

Series 2.—In this series glycerinated small-pox crusts were used. As before, the crusts were from Gloucester. Two samples of emulsion were made; in the one case small-pox crusts were mashed up in undiluted glycerine, in the other the crusts were mashed up in equal parts (sterilised) of glycerine and beef broth.* Both samples were kept previous to testing from two to four weeks in small sterile glass-stoppered bottles, or in sterile test tubes plugged with sterile cotton wool. Eleven eggs were comprised in this experiment; but from coverglass specimens of none of them were bacilli obtained similar to those I have in my former paper recorded as discoverable in fresh small-pox lymph. The only micro-organisms resulting from culture of the material from the interior of these eggs were a spore-bearing bacillus corresponding to bacillus mesentericus, and staphylococcus aureus. More than half the eggs were found to be sterile.

Hereafter, in the early months of 1897, I limited my observations to the microbes to be obtained from variolous matter with solid media as a cultivating ground.

III.—*Solid Media as Cultivating Ground for the Microbe of Variola.*

Acting, as before, on the indicia furnished by Drs. Copeman and Blaxall in their paper read at the Liverpool Meeting of the British Association, I made use of glycerine as a means of inhibiting the growth and multiplication, in my artificial media, of the numerous "extraneous" microbes commonly present in small-pox crusts. Samples of such crusts, obtained some months previously from Gloucester, were mashed up and thoroughly mixed, some with undiluted glycerine, others with beef broth containing glycerine in varying proportion. The emulsions thus made were placed in glass-stoppered bottles, which were kept at the temperature of the laboratory for different periods before testing of their contents by inoculation of nutrient agar and of glycerine agar. My procedure in testing these emulsions from time to time was as follows:—

Ordinary nutrient agar and glycerine nutrient agar having been melted and poured out into separate sterile plate-dishes, and allowed to set, a sample of some of the emulsion of mashed small-pox crusts was drawn up into a freshly-made glass capillary pipette, and three droplets therefrom were deposited on the surfaces of each of the media in question. Next, with the flat blade of a sterile platinum spatula (bent at an obtuse angle against the handle), the three droplets thus deposited were carefully and gently spread over the agar surface, the plate-dishes were duly covered over, and were incubated at 37° C. After two or three or more days, all the colonies able to grow on these media had commonly made their appearance, and could easily be studied.

* Herein I followed the plan advocated by Drs. Copeman and Blaxall in their paper read in the Physiological section of the British Association at Liverpool, September 1896.

App. B. No. 6.

On the Microbes of Vaccinia and Varolia; by Dr. Klein.

I. *Small-pox Crusts mashed up and preserved in Undiluted Glycerine.*—As a matter of course, surface plate cultivations made (with droplets in the above fashion) only a few weeks after establishing an emulsion, yielded a large number of colonies. Amongst these colonies staphylococcus aureus and albus, and bacillus mesentericus, were very conspicuous. But when four months had been allowed to elapse before testing, three droplets of the emulsion yielded, comparatively speaking, a limited number of colonies only. Amongst them were a few colonies of bacillus mesentericus, a larger number of colonies of staphylococcus aureus, several colonies of different bacilli presently to be mentioned, and usually not more than one colony of one or another streptococcus. As showing how persistently some microbes originally present in the crusts preserve their vitality in undiluted glycerine, I may mention a plate cultivation made on glycerine agar with one big drop of a crust emulsion in undiluted glycerine nine months old. In this plate there came up:—

14 colonies of stayhylococcus aureus and sarcina lutea.
1 colony of streptococcus.
1 colony of staphylococcus albus.
11 colonies of various bacilli to be described below.

Fig. 12 gives a photographic representation of this plate.

It appears, therefore, that undiluted glycerine, although germicidal to a good many microbes, does not possess the power to kill off by any means all microbes that can grow on the surface of ordinary media, such as nutrient agar and glycerine agar. In this sense it is inferior to the 50 per cent. solution recommended by Dr. Copeman.

Having as a result of a large number of preliminary experiments ascertained that the germicidal effect of the glycerine on the microbes in small-pox crusts was much the same with glycerine broths of the strengths of 40, 50, and 60 per cent., I subsequently made use of equal parts of beef broth and glycerine for my small-pox crust emulsions.

II.—*Small-pox Crusts mashed up and preserved in* 50 *per cent. Glycerine Broth.*—Surface plates inoculated in the manner already described with a single droplet of the fresh emulsion, presented after incubation for a day or two numerous colonies of staphylococcus aureus and albus; also a few colonies of bacillus mesentericus.

Surface plates on agar made *18 days* after establishment of the emulsion—three droplets of emulsion being used for each plate—yielded bacillus mesentericus, a nondescript bacillus, a single colony of streptococcus, several colonies of staphylococcus (also, sarcina lutea), and staphylococcus albus.

A surface plate on agar made with three droplets of the emulsion *25 days* after it had been established, yielded six colonies of sarcina lutea, four colonies of a bacillus to be presently described, and three colonies of staphylococcus albus.

A surface plate on agar made of the emulsion *six weeks* after it had been established yielded two colonies of bacilli to be presently described.

Similar surface plates made from the same emulsion after *two months*, and after *two months and a half*, yielded in no instance any colonies.

From this it follows that 50 per cent. glycerine broth has undoubtedly a destructive power on the microbes in variolous crusts capable of growing on agar surface; a power which, although it is noticeable to a certain extent after lapse of two or three weeks, becomes more pronounced after 25 days, and is very conspicuous indeed after about six weeks. It would seem, indeed, that 50 per cent. glycerine broth is, as a destructive agent of these microbes, distinctly and conspicuously more potent than

undiluted glycerine. The period, however, of a week, noted by Drs. Copeman and Blaxall as sufficing in the case of 40 per cent. glycerine broth for sterilizing, so far as extraneous microbes are concerned, crusts of small-pox, is in my experience too short. This different result obtained by me may be due to the fact that in all my experiments comparatively large doses—one big drop, or three small droplets of emulsion—were used for surface plate cultures. Had I used a much smaller amount, as, for instance, one or two platinum loops of emulsion, the result might very possibly have been negative. Moreover, as I understand, the crusts employed by Drs. Copeman and Blaxall were "older" crusts than those used by me.

III.—*Nature of Special Microbes isolated from Small-pox Crusts.*—At the outset it is necessary to state that the number of microbes present in, or rather cultivable from, the crusts of variola, diminish in the course of time; that is, as drying of the crusts becomes more and more thorough. Thus, the small-pox crusts which were sent to me in May 1896 (they had been collected from cases of small-pox in April 1896) contained an enormous amount of microbes; amongst them numerous staphylococcus aureus and albus, sarcina lutea, and spores of bacillus mesentericus. These crusts, however, after being kept in a dry glass tube for seven months, showed, when again tested in culture, a considerable diminution of cultivable organisms.

The microbes which, in the course of my experiments, were cultivated from the above-mentioned undiluted glycerine emulsions and glycerine broth emulsions respectively, particularly the former, and which deserve special notice, are the following:—

1. *Streptococcus Erysipelatos.*—This microbe was obtained in a plate culture made from an emulsion of crusts which had been stored for over four months in undiluted glycerine. In surface and in stab cultures on gelatine and agar, in broth cultures, and in morphological respects, it was a true streptococcus. Tested on the rabbit's ear, it produced experimentally typical spreading erysipelas. This microbe was also obtained from a 50 per cent. glycerine broth emulsion of small-pox crusts which had been established 18 days. That the microbe was the streptococcus of erysipelas was proved by injection of a broth culture of it into a rabbit's ear. Definite erysipelas was produced; moreover, material from the erysipelatous ear of this animal, when injected into the ear of another rabbit, gave again a positive result.

It is clear, then, that the streptococcus of erysipelas, when it happens to be present in crusts of variola, is not readily got rid of; not necessarily by storage in undiluted glycerine for over four months, nor by storage in 50 per cent. glycerine broth for 18 days.

2. *Bacillus, or Leptothrix, Epidermidis.*—This microbe was first described by Bizzozero. He obtained it from epidermic scales from between the toes. It is a motile, aërobic, non-liquefying bacillus; forming leptothrix threads, growing slowly both on gelatine and agar as rounded translucent colonies, and forming oval glistening spores.

A microbe which I isolated from an emulsion of small-pox crust in undiluted glycerine, and which is one of the microbes capable of surviving in such emulsion for a considerable time (over four months), corresponds in its more important characters fairly closely to Bizzozero's bacillus epidermidis. It does not, however, tally with Bizzozero's description as regards the temperature at which it grows best. Bizzozero found that his bacillus epidermidis grows best at 15–20° C., which is certainly not the case with the microbe now in question. This does not grow at all below 20° C.; it grows best at 37° C. There are a number

App. B. No. 6.

On the Microbes of Vaccinia and Variola; by Dr. Klein.

of other details in which Bizzozero's bacillus does not tally with that which I have isolated from small-pox crusts. Thus Bizzozero states that the colonies of his microbe gradually coalesce, forming a rather thick layer. This is certainly not the case with my microbe; in streak cultures on gelatine and on agar its growth is always marked by rather isolated colonies, with little tendency to coalesce even when they are closely placed. The colonies are very small, and they remain small after several weeks incubation. At first they are rounded, but soon become slightly angular; but always they remain flat and disc-shaped. At first, too, they appear uniformly translucent, but gradually they become slightly opaque in the centre in transmitted light; dark brown granules, gradually increasing in number and size, are noticed in the central part as early as the third or fourth day (agar at 37° C.). This appearance is, as microscopic examination proves, due to copious formation of spores. The aspect and nature of the colonies, the size and character of the cylindrical bacilli forming them, their tendency to form leptothrix in their early stages, and their oval, centrally-placed spores, are well shown in Figs. 3 to 8; I need not therefore enter into any lengthy description.

The growth of this microbe at no time liquifies gelatine; in a fluid medium (broth, condensation water of agar cultures) it forms floccular white masses. Spore formation appears to proceed only in the colonies growing aërobically. Injection under the skin of guinea-pigs, rabbits, or mice of large doses of culture of the microbe produces no effect. So, too, when inoculated into the skin of the calf, it had no effect whatever. Specimens from a recent culture (agar surface), when examined in the hanging drop, show motility of some of the microbes; not of all, although on appropriate staining every bacillus appears possessed of three, four, or more flagella (Fig. 6).

It may not be without interest to mention that for the purpose of isolating this microbe from glycerine emulsion of crusts of variola, the best medium is broth-agar, the broth for which is obtained from fresh calf-skin devoid altogether of muscle. On this medium the microbe grows very readily, and forms copious spores sooner than on other media.

3. *Bacillus Xerosis variolæ.*—This is a non-sporing, non-motile bacillus which was isolated by surface agar plates from an emulsion of small-pox crusts in undiluted glycerine nine months old. Also it was obtained from small-pox crusts in emulsion with 50 per cent. of glycerine broth for about 25 days and 33 days respectively. In the case of crusts kept mashed up in undiluted glycerine for nine months, an agar plate yielded 27 colonies, eight of which were composed of bacillus xerosis. In the case of a glycerine broth emulsion established 25 days, one surface plate made with three droplets yielded six colonies of sarcina lutea, three colonies of staphylococcus albus, and four colonies of the bacillus xerosis under consideration. In the case of a glycerine broth emulsion 33 days old, three droplets yielded on an agar surface plate a single colony of the bacillus xerosis.

The colonies of bacillus xerosis are marked by their slow growth on agar at 37° C., and by being small and flat. They are translucent in the peripheral portion, their centre being granular under a glass (*see* Fig. 11. Their shape is round, but at later stages (two weeks or so) their margin is seen, with a glass, to be more or less regularly crenated and lobed, so as to resemble the corolla of an aster. Examined under a low magnifying power, the early colonies (about a week) appear round with somewhat irregular margin and granular; the colonies are very small, as will be inferred from Fig. 10, which represents the

colonies at least 5 times magnified. Examined under high powers, the colonies are seen to be composed of minute bacilli, which in size and shape are not unlike diphtheria bacilli but correspond more closely, perhaps, with the so-called pseudo-diphtheria bacilli, at present considered as a group, and called bacillus xerosis. Bacilli of this group resemble, as has been said, in size and shape the Klebs-Löffler, or diphtheria bacillus (*see* Fig. 9). They are cylindrical, often conical, and some are possessed of club-shaped terminal enlargements. Many of the cylindrical or conical bacilli show a segregation of their protoplasm into granules or knobs, which in the long forms (particularly when terminating with a club) is characteristic of the diphtheria bacillus and of the pseudo-diphtheria bacillus. The pseudo-diphtheria, or xerosis bacilli are without any physiological action on guinea-pigs or other rodents, and herein are in strong contrast with diphtheria bacilli. The xerosis bacilli resemble the diphtheria bacillus in the aspect of the colonies on agar; but they differ in not producing acid reaction in broth culture, and in not turning blue litmus broth red.

The bacillus thus isolated from variola crusts resembles, therefore, the xerosis bacilli in morphological respect, but it differs from the classical xerosis bacillus in the extreme minuteness of its colonies. It does not grow, or grows only extremely feebly, in gelatine at 20° C. It grows better on ordinary agar than on glycerine agar at 37° C.; in streak culture it does not grow continuously, the line of inoculation remains composed of discreet small colonies (*see* Fig. 10).

On injection of large doses of culture of this microbe under the skin of rodents, no disease was produced. I also inoculated two calves in numerous cutaneous insertions with culture of the bacillus, but without result. The incisions remained unaffected by the culture, and after about three days they were dried up and healing.

4. *Bacillus albus variolæ.*—This is a microbe which, like the bacillus xerosis, survives a very long while in the crusts of small-pox, whether these are emulsified with undiluted glycerine or with 50 per cent. glycerine beef-broth. I have isolated this microbe from an emulsion of the variola crusts in undiluted glycerine after it had been set up nine months; out of 27 colonies growing on the surface of an agar plate inoculated with three droplets of the emulsion, eight were colonies of the xerosis bacillus, three of the bacillus albus.

This microbe I have called *bacillus albus variolæ* for the reason that its colonies, as also its growth in streak on the surface of agar, are of pure white colour. They are moist looking, and, when isolated, grow fairly rapidly, and are somewhat raised. Colonies on the surface of the medium are round (Figs. 19, 20, 21). When very young (agar at 37° C. for two days) they are small and translucent; but after two or more days they become opaque and white, measuring five to ten millimetres in diameter. One very striking character possessed by these colonies helps in a marked degree to identify them. It is that on trying to take up with a platinum needle a particle of the growth of the colony, this is effected only with difficulty; and, further, that having succeeded in taking up a particle of the growth, such particle does not, placing it in a drop of water, salt solution, or broth material, distribute itself readily, as is the case with most other microbes, but requires a good deal of rubbing, teasing, and mashing in order to spread it out, the component elements remaining even then largely agglutinated into small or larger clumps.

In stained coverglass specimens, under the microscope, the microbes constituting a young colony are small delicate rods or cylinders, uniform or granular, and with rounded ends, measuring on an average about

App. B. No. 6.

On the Microbes of Vaccinia and Variola; by Dr. Klein.

$0{\cdot}8\mu$–1μ; the thickness of the rods being about one third or one fourth of the length. These bacilli are always grouped together by a homogeneous interstitial substance. The microbes are often placed end to end, so as to form a dumb-bell. As regards size, these bacilli correspond to those described in my report of the Local Government Board, 1892–93, as found in the clear lymph of variola and in the early lymph (72–96 hours) of calf vaccinia. If stained specimens are made of a growth of the microbe on agar after one, two, three, or more days incubation, a characteristic change is observed. Not only do some of the bacilli look more cylindrical, knobbed, resembling in a remarkable manner the forms found in growths of the diphtheria bacilli, but at the same time there is observed a condition which is not present either in diphtheria or in xerosis bacilli. This is that amongst the typical thin bacilli there are present forms, single or in dumb-bells, which are markedly thicker; the thickening being due to a conspicuously and deeply-stained sheath. These bacilli stand out conspicuously, and look as if some additional substance had been formed around them, which takes and retains the stain very tenaciously. That this is the case is proved by the fact that if, after staining in gentian-violet, film specimens of the growth are well washed in alcohol, the ordinary typical bacilli are greatly reduced in colouring, become more faintly stained, whereas the above thick forms now stand out very deeply stained. Figs. 14, 15, and 16, show this well. The more advanced the culture, the more numerous are these thick deeply-stained bacilli. As time proceeds numerous bacilli become vacuolated at one end or in the middle; in some of them the part of the bacilli outside the vacuole assumes greater thickness and greater staining power. In broth cultures, besides changes of the above sort, knobs, clubs, and segmented thick forms appear, all deeply stained (Figs. 14 and 18 are very good representations of these changes). Now, the deeply stained thick forms—round, oval, club-shaped, rod-shaped, single, or dumb-bells—behave like spores on staining with hot fuchsin, then washing in alcohol, and afterwards in methyl blue; for they retain the fuchsin, whereas the ordinary bacilli become decolourised by the alcohol taking then the blue stain. At first one might be disposed to consider them involution or degeneration forms, as also the club-shaped diphtheria bacilli were formerly thought to be. These club-shaped diphtheria bacilli, however, I have shown to be actively growing, not degenerating forms, and in the case of bacillus albus variolæ, be it noted, the process of thickening of the bacilli, and with it the power of retaining the fuchsin stain, is detectable, and can be observed, gradually afterwards increasing, in the very early stages of the growth.

Morphologically, therefore, the bacillus albus variolæ belongs to the group of diphtheria and pseudo-diphtheria (Xerosis) bacilli, differing however, from them in the circumstance that some of the rods develop into thicker, more deeply stained, masses, behaving, indeed, like spore forms. I presume this accounts for the fact that even after lapse of several months, new active sub-cultures can be easily established from an original culture.

The bacillus albus variolæ grows well on ascites agar, on ordinary agar, and on glycerine agar. It grows very feebly on gelatine at 20–21° C.; the colonies take many days to develop, and remain very minute points.

In streak culture on agar the streak becomes a white band, made up of more or less confluent colonies, at first translucent, but soon opaque in transmitted light.

Subcutaneous injection of agar culture of this bacillus into guinea-pigs and rabbits produces no effect. But cutaneous insertion of such culture into the calf produces very interesting results, and these I

proceed now to describe. It is important to note that they were all made early in 1897 at the Brown Institution, when no vaccination had been going on there that might have vitiated the experiments.

Experiment I.—A bull calf, No. 1, was inoculated in 49 linear cutaneous incisions, in the inguinal and abdominal regions and on the scrotum, with culture of bacillus albus grown on the surface of agar. Two cultures were used, a recent one, two or three days old, and one which had been established two or three weeks. The insertions were of exactly the same kind as are practised in ordinary calf vaccination.

For the first five or six days the insertions seemed to have all failed; there was no redness or swelling, and they seemed to be drying. By the seventh or eighth day, however, two of the insertions on the scrotum seemed to be slightly thickened and reddened, all the other insertions having, by this time completely healed. The two insertions on the scrotum remained red. By the 12th and 13th day, the redness of the skin immediately around them had considerably increased; the insertions themselves were raised; the skin thickened, infiltrated, and covered with a broad thick crust; at one of the two insertions, there was an indication of marginal vesiculation. On the 15th day the swelling and redness was still more pronounced, and the insertions were covered with broad thick scabs.

Experiment II.—On this (15th) day both the above insertions on calf No. 1 were scraped, and the material thus obtained inoculated into a female calf, No. 2, by 10 cutaneous incisions. By the 6th day six of the above insertions in calf No. 2 seemed to have quite failed and dried up; the remaining four were slightly red, thickened, and covered with thin scab. On the 12th day the success of the above four insertions was pronounced, one being a vesicle with depressed central scab and redness around it, one merely a red thickening with thick scabs. As regards both these insertions, the skin underneath appeared much infiltrated. The two other successful insertions were marked by redness, thickening of the skin, and thin crust on the surface.

Experiment III.—The two insertions on calf No. 2 nearest approaching success were scraped, and the material thus collected inoculated by twelve cutaneous incisions into calf (female) No. 3. Four of these twelve insertions had quite dried up and failed by the fourth day, but the other eight were red, swollen, and pustular, with purulent contents. So that not only was success greater with this calf than with the others, but the local manifestations of success were greatly accelerated.

Experiment IV.—The above purulent pustules of calf No. 3 were scraped, and the matter thus obtained inserted into 24 cutaneous insertions in calf No. 4. As I expected, the great majority of these 24 insertions in calf No. 4. took, but in a greatly accelerated fashion. They were purulent pustules already on the 4th and 5th day.

It appears, then, from these experiments that with culture of bacillus albus some pronounced result was obtained in two out of 49 insertions in calf No. 1; and that the nature of the result as regards these two insertions was similar to that I described in 1892–93 as obtained by direct insertion of small-pox lymph into the calf. As before, after some days of seeming failure, one or more insertions became thickened and red, the scab over the incision thickened and broadened; change of this sort increasing during several successive days. The success in calf No. 2, however, in the present series—*i.e.*, in the first remove from the original calf—was more pronounced, some of the insertions approaching more nearly the condition of vesicles. Unfortunately, the next transfer

in this instance (to calf No. 3) seems to have been made at too late a stage of the lymph employed; for the result was greatly accelerated (purulent pustules).

It will be remembered that in the experiments of 1892–93, I started by inserting small-pox lymph into a calf, and obtained after further cultivation in successive calves material from the successful insertions of the last of the series (fourth remove) which, when inserted into the arm of an infant, produced typical vaccinia, and which after retro-vaccination from this infant into the calf produced also typical vaccinia in other calves. In order to ascertain whether in the present experiments the process to which the above series of calves had been subjected had protected them in any way against vaccinia, it was necessary to test these calves with current calf lymph.

Consequently seven weeks after all trace of local result on calf No. 1 had quite disappeared, this animal was subjected to vaccination with current calf lymph obtained fresh in tubes at Lambs Conduit Street Station. It was vaccinated by eight linear cutaneous insertions in the usual way. On the fifth day seven of these insertions had failed and had quite dried up; at one insertion, however, in a single spot there was distinct appearance of a small circular swelling. On the sixth day this spot had become an unmistakeable small vaccine vesicle. This was scraped, and with the material thus obtained calf No. 2 was vaccinated, also by eight incisions. On the sixth day one of these insertions was a fairly typical vaccine vesicle, the other seven insertions showing doubtful success. On the seventh day there was no more doubt, all eight insertions were now typical vaccine vesicles. With the scrapings from one of these vesicles calf No. 3 was vaccinated by 18 insertions. On the sixth day all 18 insertions in calf No. 3 had taken; they were typical vaccine vesicles.

It appears, then, from these experiments that only in calf No. 1, the animal in which two successful insertions resulted from inoculation of culture of baccillus albus, was there anything approaching a condition of antagonism to subsequent vaccination. Whether the fact that calves Nos. 2 and 3 in no way resisted vaccination had to do with the late stage at which bacillus albus lymph had been taken from calf No. 1 for the purpose of inoculating them, must remain for the present uncertain. It is at any rate desirable that the microbe that I have designated "bacillus albus variolæ" should be made the subject of further study.

PLATE II.

Fig. 3.

MICROBES FROM LYMPH OF VARIOLA.

PLATE II.

Fig. 3.

Bacillus leptothrix variolæ: Reproduced from a photograph of an "impression specimen" of the margin of a colony of the microbe growing on the surface of agar.

[Magnifying power, 1,000.]

MICROBES FROM LYMPH OF VARIOLA.

PLATE III.

Fig. 4.

Bacillus leptothrix variolæ: Reproduced from a photograph of a culture on the surface of agar. The filamentous character of the microbe is here well displayed.

[Magnifying power, 1,000.]

Fig. 5.

Bacillus leptothrix variolæ in sporing stage: Reproduced from a photograph of an agar culture of the microbe, after several days' incubation.

[Magnifying power, 1,000.]

PLATE III.

FIG. 4.

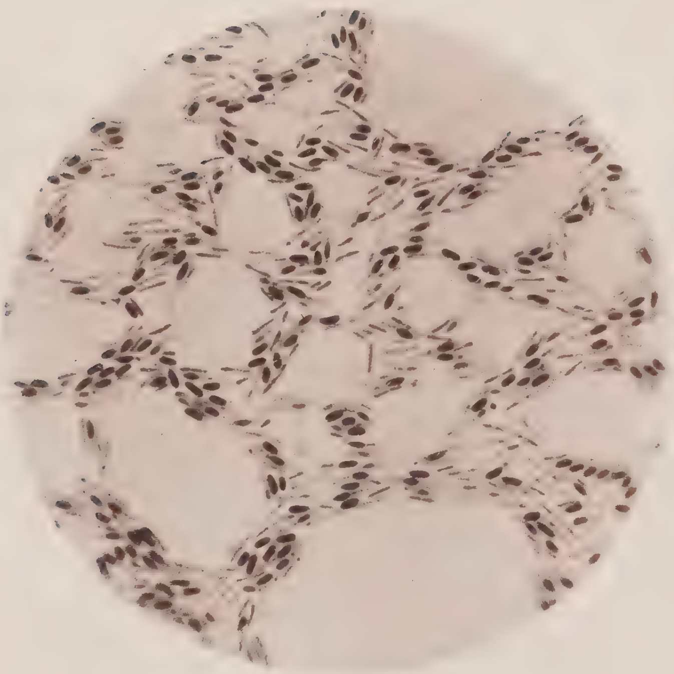


FIG. 5.

PLATE IV.

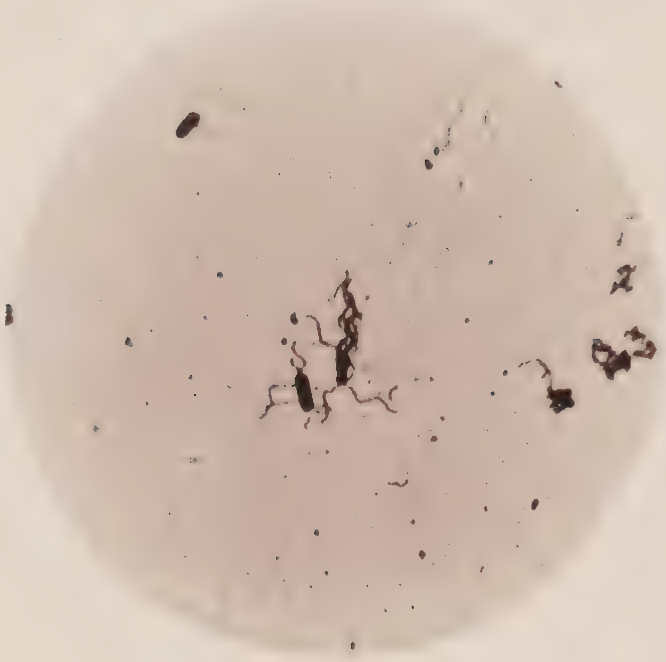


FIG. 6.

FIG. 7.

MICROBES FROM LYMPH OF VARIOLA.

PLATE IV.

FIG. 6.

Bacillus leptothrix variolæ with stained flagella.

[Magnifying power, 1,000.]

FIG. 7.

Bacillus leptothrix variolæ in separate colonies on the surface of agar; after several days' incubation.

[Natural size.]

MICROBES FROM LYMPH OF VARIOLA.

PLATE V.

Fig. 8.

Bacillus leptothrix variolæ in separate colonies on agar.

[Magnifying power, 5.]

Fig. 9.

Bacillus xerosis variolæ :—Reproduced from a photograph of a film specimen from a recent culture on the surface of agar.

[Magnifying power, 1,000.]

PLATE V.

Fig. 8.

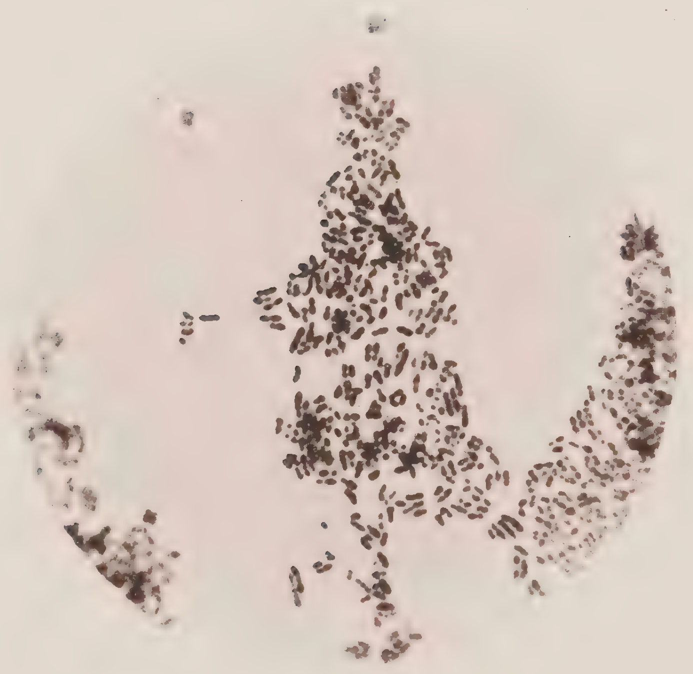


Fig. 9.

PLATE VI.

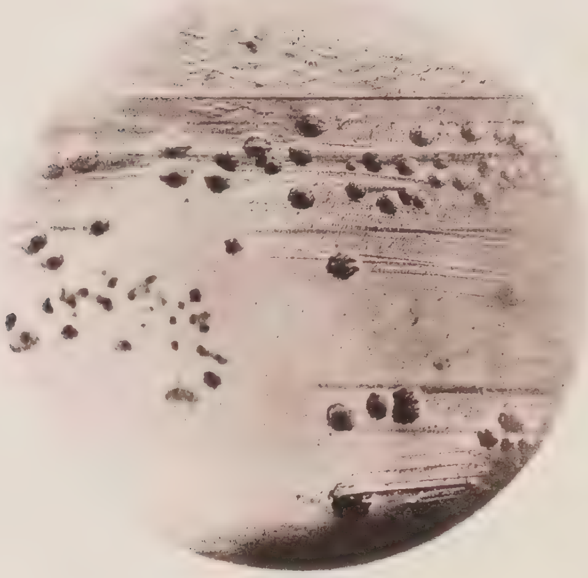


Fig. 10.

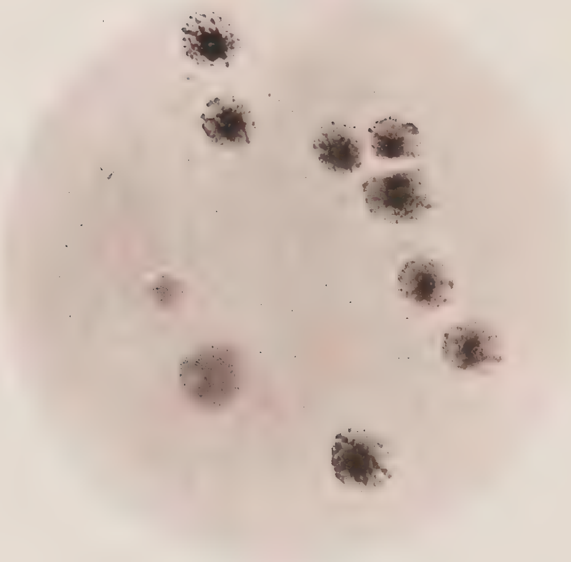


Fig. 11.

MICROBES FROM LYMPH OF VARIOLA.

PLATE VI.

FIG. 10.

Bacillus xerosis variolæ growing in separate colonies on the surface of agar.

[Magnifying power, 5.]

FIG. 11.

Bacillus xerosis variolæ growing in separate colonies on the surface of agar.

[Magnifying power, 12.]

MICROBES FROM LYMPH OF VARIOLA.

PLATE VII.

FIG. 12.

Colonies of microbes arising in an agar-plate after inoculation with powdered variola scabs which had been stored for nine months in undiluted glycerine.

[Natural size.]

FIG. 13.

Bacillus albus variolæ : Reproduced from a photograph of a film specimen from an agar culture of the microbe, incubated four days at 37° C.

[Magnifying power, 1,000]

PLATE VII.

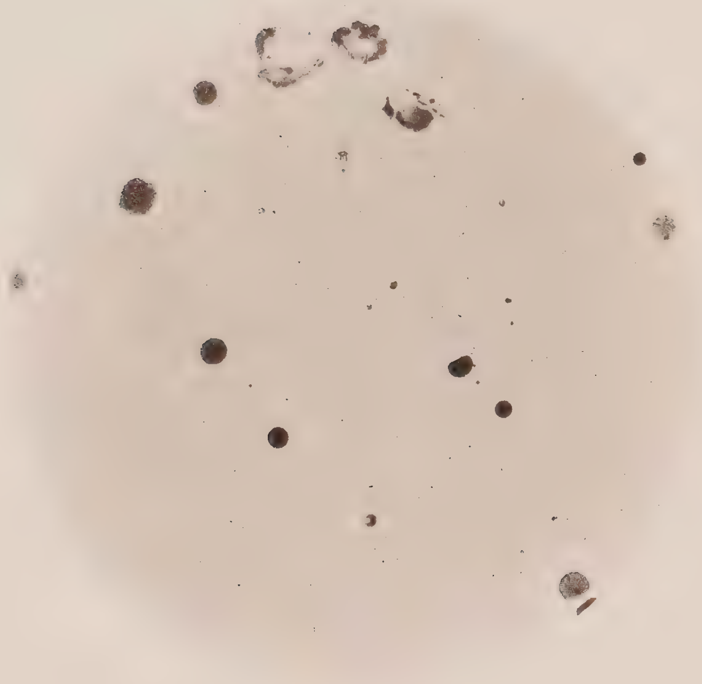


Fig. 12.

Fig. 13.

PLATE VIII.

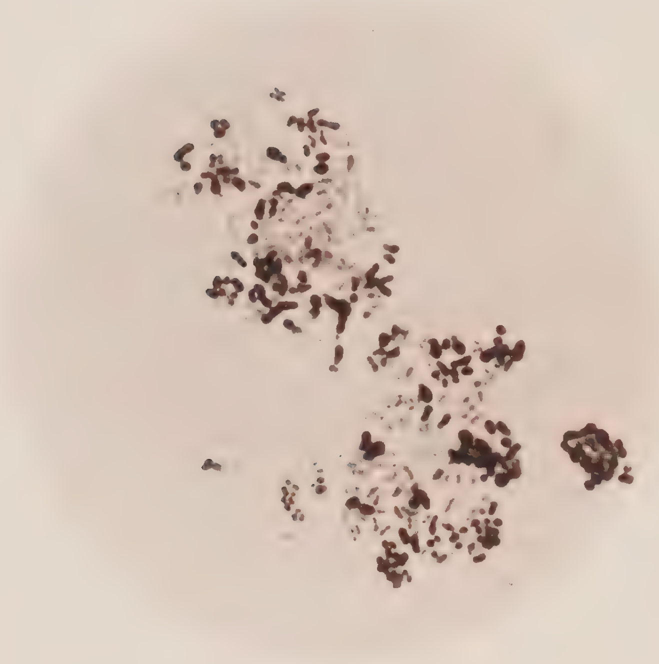


Fig. 14.

Fig. 15.

MICROBES FROM LYMPH OF VARIOLA.

PLATE VIII.

FIG. 14.

Bacillus albus variolæ in spore-bearing form: Reproduced from a photograph of a specimen from an agar culture of the microbe after several days' incubation at 37° C.

[Magnifying power, 1,000.]

FIG. 15.

Reproduced from a photograph of a specimen, similar to that depicted in Fig. 14.

[Magnifying power, 1,000.]

MICROBES FROM LYMPH OF VARIOLA.

PLATE IX.

FIG. 16.

Bacillus albus variolæ in spore-bearing and in non-spore-bearing form.
[Magnifying power, 1,000.]

FIG. 17.

Bacillus albus variolæ from an agar culture two days' old.
[Magnifying power, 1,000.]

PLATE IX.

Fig. 16.

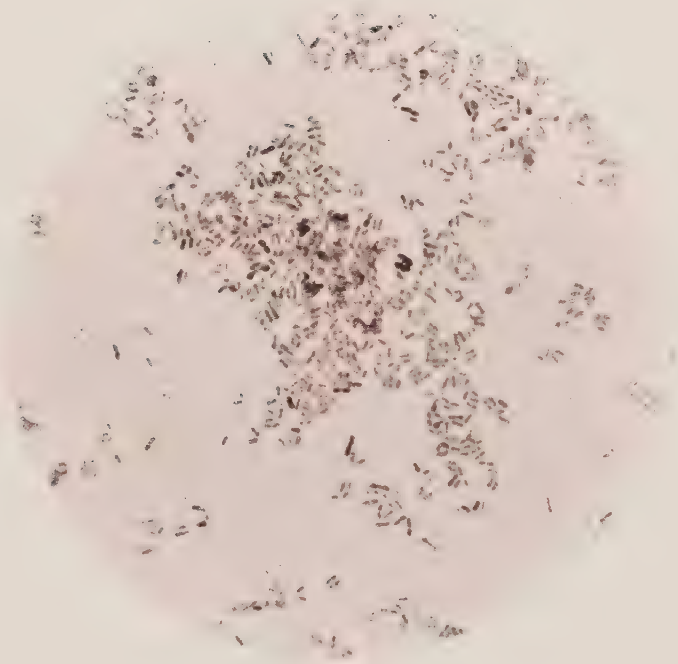


Fig. 17.

PLATE X.

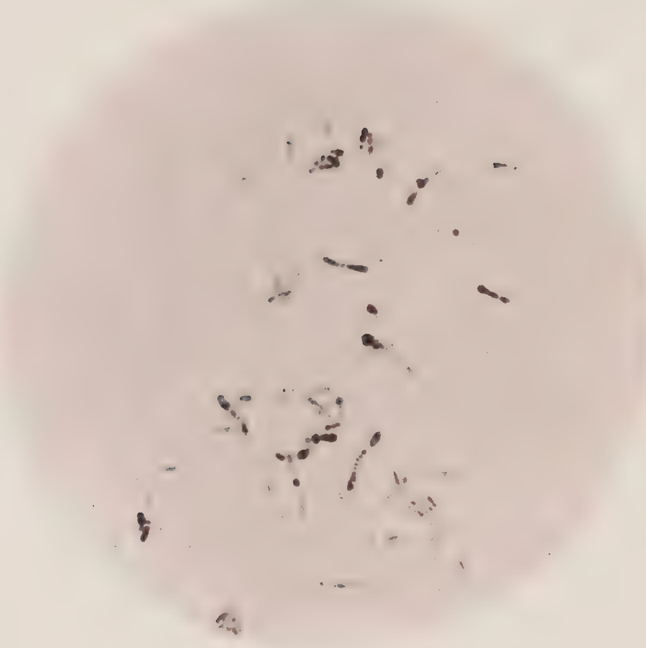


Fig. 18.

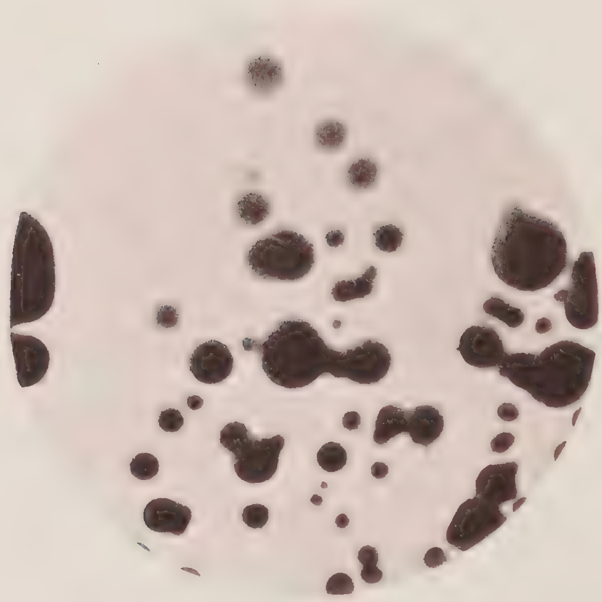


Fig. 19.

MICROBES FROM LYMPH OF VARIOLA.

PLATE X.

Fig. 18.

Bacillus albus variolæ from an agar culture several days old, showing numerous club forms.

[Magnifying power, 1,000.]

Fig. 19.

Colonies on agar of bacillus albus variolæ, after four days' incubation at 37° C.

[Magnifying power, 12.]

MICROBES FROM LYMPH OF VARIOLA.

PLATE XI.

FIG. 20.

Colonies on agar of bacillus albus variolæ, after three weeks' incubation. [Magnifying power, 12.]

FIG. 21.

Colonies on agar of bacillus albus variolæ, after three weeks' incubation. [Magnifying power, 20.]

PLATE XI.

Fig. 20.

Fig. 21.

No. 7.

App. B. No. 7. On the Bacillus of Plague; by Dr. Klein.

Observations and Experiments with the Bacillus of Oriental or Bubonic Plague; by Dr. Klein, F.R.S.

On November 26th, 1896, a culture of a bacillus growth on agar was submitted to me by the Board, which bacillus had been isolated by the British Institute of Preventive Medicine from a case of suspected oriental or bubonic plague that had occurred in the preceding October in a native of India at the Branch Seamen's Hospital, London. The attack in question was one of three which occurred among members of native crews, and which have been duly reported on to the Board by Dr. Buchanan of the Medical Department. The above bacillus culture, which was furnished to the Board as affording a sample of the plague microbe obtained from the body of a person dying of plague in this country, was examined by me microscopically, by means of numerous subcultures, and by experiments on rodents. It was what it professed to be, namely, a pure culture of the micro-organism of bubonic plague discovered and described by Kitasato and Yersin. It was identical in all respects with a pure culture of the plague bacillus which I had sent me some time previously from Hongkong, by Dr. Atkinson who had kindly obtained it for me from Professor Kitasato. The observations on the plague bacillus which I propose here to record, refer partly to the Hongkong culture of the microbe and partly to that furnished to the Board by the British Institute of Preventive Medicine.

A.—Morphology of the Plague Bacillus.

The plague bacillus belongs, as regards shape and size, to the group of microbes of the class that cause acute hæmorrhagic septicæmia, *e.g.*, the bacillus of fowl cholera, of swine fever, &c. It is a minute oval or rod shaped bacillus with rounded ends (Fig. 22), occurring singly or as dumb-bells, not liquefying gelatine, and causing acute septicæmia in one and another rodent.

The plague bacillus obtained from the inguinal lymph tumour or from the blood or the viscera of an animal infected with and dead from the disease (Figs. 23 to 26), is, in the majority of instances, a minute rod of $0 \cdot 8$—$1 \cdot 6\mu$ in length, in stained and well-washed specimens showing at each end a polar granule. It occurs, as I have said, singly or as dumb-bells; occasionally one or another element is cylindrical, of considerable length, and even thready. In the blood of the infected animal most of the microbes are arranged as dumb-bells; in the spleen and lymph glands cylindrical bacilli are not rare; in the peritoneal fluid (after intra-peritoneal injection) chains of rods are in the majority. In artificial cultivation both on gelatine and on agar, cylindrical bacilli and even threads are met with amongst preponderating oval rods and oval dumb-bells. The plague bacillus is non-motile. In no single instance, when cultures, or animal fluids, or tissues were examined in the hanging drop, was there any mobility noticeable beyond the Brownian molecular

movement. Moreover, staining, after Van Ermengem's method, failed to demonstrate the presence of flagella.*

The plague bacillus, both of cultures and of the animal tissues and fluids, was carefully examined by me for the presence of a capsule. Occasionally a clear halo was seen surrounding a bacillus, alike in fresh and dried and stained specimens, particularly the latter. But nothing of the nature of a well-defined and separate capsule could be detected, such, for instance, as is present on the diplococcus pneumoniæ and other well known capsulated microbes; and this notwithstanding use of dyes, such as easily stain the capsules of the pneumococcus and of Friedlander's bacillus. There is no doubt, however, that something superadded to its thin normal sheath is often present on the outside of the microbe; for, besides the above referred-to small halo, there is, in silver stained (flagella) specimens, always a finely granular, faintly stained envelope noticeable around the bacillus. That there is present between the individual bacilli forming a colony in artificial media, particularly on agar, or between the microbes clustered in the tissues—lung, spleen, lymph glands—some kind of gelatinous material which binds them together, is indeed shown by the fact that the aggregations are with some difficulty broken up into their elements. The above does not, however, apply to the blood of infected animals. Herein the bacilli are found as isolated short rods, and as dumb-bells of rods; and, as already mentioned, they are in the fresh, as also in well stained specimens, seen to be surrounded by a narrow clear halo, which is not stainable like a true capsule.

B.—Cultural Characters of the Plague Bacillus.

The plague bacillus grows rapidly on agar (beef-broth agar, peptone and salt) at 37° C., forming in streak culture a translucent grey, slimy, viscid, linear growth, which rapidly spreads out into a band with crenate or knobbed edges.

On gelatine (beef-broth gelatine, peptone and salt) the plague bacillus grows, at 20–21° C., well and rapidly, forming already after 24 hours grey punctiform colonies, which, under a glass, are translucent and angular (Fig. 33). After a few days (three to seven), the superficial colonies are greyish white, angular, more or less rounded patches, distinctly thicker and more or less acuminated in the centre. They appear for this reason like conical elevations; their margin is angular or crenate. In transmitted light the colonies are brownish and finely granular. The colonies in the depth of the medium are small and spherical, white in reflected, brown in transmitted, light. The maximum growth is reached in about ten days to a fortnight, the largest isolated colony being then several millimetres in breadth.

In gelatine streak cultures the growth of the plague bacillus resembles that of the diphtheria bacillus, forming a gradually thickening whitish band with irregular and knobbed margin. In gelatine stab culture the line of

* Quite recently Mr. Mervyn Gordon has, however, succeeded in demonstrating the presence of one or even two fine spiral flagella on a small minority of bacilli, taken from a growth on agar after 20 hours incubation at 37° C.

App. B. No. 7.

On the Bacillus of Plague; by Dr. Klein.

inoculation becomes marked as a row of closely placed round colonies, brown in transmitted, white in reflected, light; on the top of the stab is a thick whitish expansion irregular in outline. After some weeks growth there are noticed in the upper half of the stab horizontal, nebulous, more or less thready, outgrowths connected with the colonies. These outgrowths are longest and most numerous in the upper part of the stab and diminish in number and length towards the depth of the medium; in the deepest parts they are absent.

In alkaline beef broth peptone salt, the growth at 37° C. is very good; the broth is already turbid in 24–48 hours, though the turbidity is never very marked. There are, however, soon present flocculi and granules which increase at the bottom as time goes on (after three or more days of incubation), and at the same time there appears on the surface of the fluid an indication of an imperfect, whitish, brittle pellicle which, on shaking, easily breaks up and settles at the bottom of the fluid. After about a fortnight the maximum growth has been reached, and the fluid then begins to clear, the floccular and granular precipitate increasing meanwhile to a corresponding extent.

The plague bacillus grows also in milk; but the milk remains unchanged in appearance, and there is no curdling. Alkaline litmus broth and litmus milk, remain for a long time unchanged in their reaction by the growth in them of the plague bacillus; only after being incubated at 37° C. for a month, is the inoculated milk found curdled and the litmus turned red.

A very characteristic appearance is presented by the surface colonies of the bacillus on gelatine, if examined in impression specimens at an early phase. If cover glass impression specimens of a surface plate (a culture in a plate dish or on the slanting surface of gelatine in a tube) after 24–36 hours incubation at 20–21° C., are dried and stained, and washed and mounted in the usual manner, one notices on examining the specimens under a low power, that amongst a great number of angular typical colonies—consisting of minute oval or rod-shaped bacilli singly or more commonly in dumb-bells—there are some few colonies the microbes composing which are distinctly thready; so much so that the twisted and loop-shaped threads in such colonies can be easily recognised. Figs. 29 to 32 show this condition well. Under a higher power it is seen that besides a few cylindrical bacilli, singly or in chains, there are longer or shorter, smooth, and homogeneous threads which characterise these atypical colonies. And even amongst the bacilli which constitute a typical angular colony there are seen occasionally cylindrical or even thread-like bacilli (Fig. 28). There can be no question that these atypical filamentous colonies are colonies of the true plague bacillus. I have paid particular attention to this point, and have made a large number of surface plates in establishing the fact. These atypical thready colonies look not unlike early proteus colonies, and they are only found, as I have said, in the earlier phases of plate and surface cultures on gelatine of the plague bacillus. They are obtained indifferently from all classes of plague material. A droplet of heart's blood of a guinea-pig dead in 48–72 hours after subcutaneous injection, a drop of peritoneal exudation (after suitable dilution) of a guinea-pig dead after intraperitoneal injection, a drop of broth culture, and a salt emulsion (after suitable dilution) of a typical plague bacillus colony from the surface of gelatine in a plate or in a tube, equally well supply them. After 24 hours incubation at 20–21° C. impression specimens from a culture set up in one or the other way always yield, amongst a majority of angular typical colonies composed of short bacilli, a few atypical colonies of filamentous bacilli. I consider this fact of especial importance for diagnostic purposes.

The plague bacillus is killed by thorough drying. Thus, if a droplet of a broth culture, of a carefully prepared uniform emulsion made from a gelatine or agar culture, of blood, of peritoneal fluid, of gland juice, of lung juice, or of spleen juice of an animal dead of the disease, be spread out on a cover glass and well dried by being kept over sulphuric acid or in the incubator for from several hours to a day or two, and the cover glass thereafter be placed in broth and duly incubated, no growth at all will make its appearance. The plague bacillus is also killed by exposure to a temperature of 60° C. for five minutes. If broth be inoculated with the bacillus and exposed to 60° C. for five minutes and then incubated no growth will follow. If, however, a particle of the growth scraped from the surface of a gelatine or an agar culture be similarly treated, five or even ten minutes exposure to 60° C. is not always to be relied upon. In this case the bacilli within the clumps of material are not always not sufficiently exposed to heat; but 62–65° C. acting for ten minutes is, under all conditions, amply sufficient to kill all the bacilli. When, therefore in some of the following experiments mention is made of cultures sterilised by heat, it will always—unless otherwise stated—signify that such cultures have been exposed to 62–65° C. for ten minutes.

C.—Experiments with the Plague Bacillus.

A broth culture, 0·1 of a cubic centimetre of which, after 5–6 days incubation at 37° C., when injected subcutaneously into a guinea-pig of about 200 to 300 grammes weight, causes death in 48–72 hours, is to be considered as a broth culture of full virulence. Similarly, a gelatine surface culture (in three streaks 6 centimetres by 2 centimetres) grown at 20–21° C., for a week or two, or an agar surface culture (6 centimetres by 2 centimetres) grown at 37° C. for a few days, may each be considered of full virulence, if 0·5 cubic centimetres of a distribution of the culture in 10 cubic centimetres of sterile broth (*i.e.*, $\frac{1}{20}$ of a culture), when injected subcutaneously into a guinea-pig of about 300 grammes weight, produces death in 48–72 hours. The blood of a guinea-pig that has died in the typical time (48–72 hours) after subcutaneous injection, the juice of its inguinal tumour, as also a salt distribution of its spleen tissue or of its peritoneal viscid fluid, causes on subcutaneous injection into another guinea-pig death in the typical time, though only a drop or two are used for injection. The peritoneal exudation of guinea-pig, dead after intraperitoneal injection, when used intraperitoneally in amount of $\frac{1}{4}$–$\frac{1}{2}$ cubic centimetre, may indeed cause death in as short a time as 24 hours.

Cultures on gelatine retain their full virulence much longer than agar cultures or than broth cultures, the latter two having been grown at 37° C. In order to produce death of the experimental guinea-pig with old gelatine, old agar, or old broth cultures, it is necessary to use large doses; the older the culture the less virulent it is. But by their passage through the animal body the bacilli from old cultures regain at once their full virulence. The most virulent materials I have found to be the viscid peritoneal exudation (which is always densely crowded with the bacilli), and recent—about three days old—broth cultures made from the blood.

Subcutaneous Injection of Guinea-pigs with Fatal Doses of the Plague Bacillus.

Wild and tame rats, mice, and guinea-pigs are all very susceptible to plague infection; rabbits are only slightly susceptible. Owing

to the high susceptibility of, and the corresponding greater facility of experimentation with, guinea-pigs, I prefer these animals to rats or mice. The bulk, therefore, of the experiments which I have made, and which now proceed to describe, were made on these animals, *i.e.*, guinea-pigs.

When a guinea-pig is injected subcutaneously in the groin with a full virulent dose of plague material it dies in 48–72 hours. Of course, it may die in less than 48 hours, even within 24–30 hours, if the dose is large: and on the other hand it may not die until after four, five, or more days; or it may recover if the dose is too small. My present purpose, however, is to deal with the symptoms during life and the post-mortem appearances in an animal of about 200 to 300 grammes weight, which has died in 48–72 hours as the result of an ordinarily fatal dose.

The day following such injection, the inguinal region is found swollen and soft, and the hind leg of the injected side is slightly drawn up. In the soft tumour, firm swollen lymph glands are to be felt; but the animal appears as a rule lively and feeds well. Forty-eight hours after injection the tumour has considerably enlarged; in some cases it attains the size of a pigeon's egg, and the hind leg of the injected side is much drawn up. The tumour is now firmer, but a soft gelatinous swelling extends from it over the abdomen and even over the chest; the temperature of the animal is raised; it is quiet and does not feed; in the course of the day its movements become less and weaker; its temperature begins to fall below normal; and the animal is found dead in about 60–66 hours.

On post-mortem examination the following conditions are found: In the inguinal region of the inoculated side is a tumour firmly adhering to the skin and the subjacent muscular tissue. This tumour varies in size from that of a small bean to that of a filbert; occasionally it is, as I have said, as large as a pigeon's egg. On cutting into the tumour a quantity of sanguineous turbid serum oozes out; the tissue of the tumour is streaked with extravasated blood and with whitish purulent matter, while its core consists of the inflamed lymph glands of this part. Around the firm tumour and extending sometimes over the whole of the abdomen even to the throat of the inoculated side, the subcutaneous tissue is infiltrated with gelatinous blood-streaked material. The lymph glands in the pelvis are enlarged and hyperæmic; the intestine as a rule congested; the spleen more or less enlarged, but on section is not juicy; the malpighian corpuscles are very distinct and pronounced, occasionally appearing as greyish conspicuous nodules and patches; the liver is congested, and in some instances shows in its substance minute grey points or even grey irregular patches. The peritoneal cavity does not as a rule contain any fluid, only occasionally is there a little viscid, grey, turbid exudation. But I have noticed that when a fatal dose of recent broth culture is injected subcutaneously, there is, in the majority of instances, very little appearance of subcutaneous tumour, and that at the post-mortem examination is there intensive peritonitis with more or less copious exudation into the peritoneum of a viscid grey, turbid, sanguineous character. Under the microscope such exudation contains a very large number of leucocytes, some red blood corpuscles, and is densely crowded with plague bacilli. The pericardium contains a quantity of slightly turbid exudation; the right heart is distended and (a few hours after death) filled with coagulated blood. The lungs are slightly congested.

If, however, death be delayed beyond 72 hours, the lungs are the seat of inflammation, and the longer death is delayed the more pronounced is this condition. In cases when death occurs four, five, or six days after injection, besides numerous petechiæ, considerable areas of the lungs are found in a state of red hepatisation, presenting also

numerous small and large round or irregular grey necrotic patches. But, as I have said, in the typical cases, *i.e.*, when death occurs between 48 and 72 hours, the lungs are found free of such conspicuous changes.

As to the distribution of the plague bacilli within the body of the experimental animal: Film specimens, made of the juice or serum of the subcutaneous tumour or of any inflamed lymph gland, show this fluid to be densely crowded with the bacilli. The appearances are in this respect characteristic; lymph cells, red blood corpuscles, and the whole intervening fluid matrix are densely packed with plague bacilli. These are short ovals (with polar staining) for the most part; some rod-shaped forms (also with polar staining), both singly or in dumb-bells; and a few cylindrical bacilli.

Film specimens of the spleen, made by drawing a cover glass over the cut surface of the tissue, show the same characteristic dense aggregations of bacilli, such, indeed, as is not observed in any other septicæmic infection of the guinea-pig. Film specimens made—in the cases where death is delayed—of the cut surface of the inflamed lung, both of the red hepatised parts and of the greyish necrotic patches, show similar dense accumulations of plague bacilli.

The peritoneal exudation, in the cases of intraperitoneal injection (also when exudation is present after subcutaneous injection of broth culture), is densely filled with plague bacilli. Here, also, there has to be noted a condition which is very characteristic of plague, viz., the bacilli form longer or shorter chains of minute oval bacteria (Fig. 27). Some of these chains are in groups and in convolutions, and in such groups particular chains are sometimes of considerable length, and difficult to distinguish from streptococcus chains. Culture, however, proves them to be typical plague bacilli.

The blood of the heart examined as stained film specimens always shows a fair number (2–12 per microscopic field) of the bacilli, mostly as dumb-bells of short ovals. But, on culture of the heart-blood, it is discovered that the number of bacilli in the blood is really very large indeed; a small droplet of blood rubbed over the slanting surface of gelatine or agar yields an almost confluent mass of colonies. Only occasionally is the number of bacilli so great in the blood that every field of a cover-glass specimen of it shows very numerous bacilli.

As is clear from the above, in order to obtain isolated colonies of plague bacilli from the juice of the inflamed lymph glands, from the spleen tissue, from the peritoneal exudation, or from the juice of the inflamed lung, high dilution (with sterile water, salt solution, or bouillon) has first to be made. Elsewise even the smallest droplet rubbed over the surface of the culture medium yields a confluent mass of colonies. And for the same reason a small quantity—a drop or two of the juice of the inguinal lymph gland, of the spleen, of peritoneal exudation, or of inflamed lung exudation—is sufficient to produce in the guinea-pig, on subcutaneous or on intraperitoneal injection, the typical disease, followed by death.

In guinea-pigs dead of the typical disease after subcutaneous injection, there is, as a rule, congestion of the upper part of the small intestine; the duodenum is relaxed, and contains fluid in which are suspended flakes containing continuous masses of the epithelium of the mucous membrane. In the duodenal fluid and also in the epithelial masses plague bacilli can be demonstrated by plate cultivation. They are, however, more easily demonstrated by injecting into the subcutaneous tissue of a fresh guinea-pig some of the contents of the duodenum. By this means the typical disease and death will be produced; viz., inguinal tumour and enlarged spleen, the juice of the tumour, the tissue of the spleen,

and the blood containing the plague bacilli in pure culture. From this it follows that in a guinea-pig affected with the disease the bacilli pass into the contents of the inflamed small intestine, and further that these bacilli can live and thrive in the small intestine.

Another interesting fact is this: When death of the experimental animal is delayed, and the lungs are, as has been said, found more or less extensively inflamed with small and large necrotic points and patches, the exudation in the bronchi and trachea always contains, as culture experiments show, the plague bacilli in considerable numbers. But it was to me rather a surprise to find, as was the case in a good many experiments made in this direction, that even when death occurs in the typical time—48–72 hours—and when, therefore, the lungs show no conspicuous disease, colonies of the plague bacilli can be obtained by culture from the surface of the trachea and the larynx. The trachea and larynx of such an animal having been opened carefully so as to avoid its mucous membrane being contaminated with blood, and a sterile platinum loop having been drawn gently and carefully once over the surface of the mucous membrane, the trace of material adhering to the platinum loop may be smeared over the surface of gelatine or agar, and these media duly incubated. If this be done, it will be found that several colonies of the typical plague bacillus will make their appearance. If such a condition obtains also in man—and the inflamed condition of the lungs in man affected with plague would suggest it—the infectivity of the expectoration, inclusive of saliva mixed with it, would necessarily follow. This, indeed, is actually the case in influenza, where the specific microbe is present in these fluids.

Sections made after hardening and staining of the different viscera of guinea-pigs dead of the disease, show that many of the smallest blood vessels are plugged with continuous masses of very minute plague bacilli. This was particularly found to be the case in the spleen, liver, and inflamed lung, the surrounding tissue being in a state of necrosis. From these vessels blocked with bacilli can be traced hæmorrhages into the surrounding tissue with scattered bacilli, which also at one and another point have multiplied so as to form larger or smaller aggregations.

Sections through the liver show that the interlobular veins contain masses of bacilli extending into the intralobular blood capillaries. In the spleen, vessels of the malpighian corpuscles, as also of the pulp, are plugged with bacilli; the tissues around them are necrotic and do not stain with dyes.

When the lungs exhibit red hepatisation in larger or smaller portions—as is invariably the case when death is much delayed—and when these hepatised portions contain large and small whitish-grey nodules and patches, the following condition will be found on examining sections through the diseased portions. The air cells, the infundibula, as also the small bronchi, appear distended by and filled with exudation, which exudation contains continuous masses of very small plague bacilli. In some places it looks as if the bronchial tree of the whole lobule had been injected with the bacilli; in sections stained with methyl blue and eosin the blue masses of bacilli map out, as it were, the bronchi, infundibula, and alveoli. In other places the interlobular tissue, as also the alveolar and infundibular cavities are densely filled with extravasated blood. Numerous blood vessels and lymph vessels are found which for some distance are plugged by masses of the bacilli.

In the inflamed lymph-glands the lymph sinuses are filled with the bacilli, and these extend in a scattered way, but also at times as continuous groups, into the adenoid tissue. In the kidney, besides a few capillaries—

in the glomerli as also in the medulla—blocked by bacilli, there are numerous bacilli to be found in the connective tissue between the uriniferous tubes; within the latter no bacilli have been seen. In the few cases in which the urine after death has been drawn carefully from the bladder and used for cultivation experiments, no bacilli could be demonstrated.

It is a noteworthy fact, that although the guinea-pig is a highly susceptible animal, and though when infected with the disease its intestines and trachea contain plague bacilli, there has not been observed in a single instance, amongst my numerous experiments, any casual infection of guinea-pigs kept in the different compartments of the same cages with the infected animals.

D.—Experiments made with reference to Protection and Immunity.

(1.) *Injection of Non-fatal Doses of Living Culture.*

By using small quantities of blood taken from a guinea-pig dead of plague, or by using small quantities of pure culture of the bacilli, the disease can be produced without fatal issue. The animal shows the inguinal tumour at the seat of inoculation; but this, after several days enlargement, gradually diminishes in size, and in the course of 10–14 days may, and as a rule does, altogether disappear. If the tumour is large, the size, for instance, of a pigeon's egg, it generally opens on the surface and leads to ulceration of the skin; and in this way it diminishes in size and ultimately altogether disappears, the skin healing up. Some big tumours, however, which did not open on the surface at all, gradually diminished in size and became altogether absorbed. I have experimented with a considerable number of guinea-pigs, which, though showing considerable constitutional illness in the first three or four days, nevertheless completely recovered, the tumour quite disappearing in 10–14 days.

Cultivations made from the tumour during the first three or four days always yield positive results; namely, growth of the plague bacilli, which, on injection in suitable dose in fresh guinea-pigs, produce the typical disease and death in the typical manner. Now, it is an important fact, supported by a considerable number of experiments, that an animal that has had the disease however severely and that has completely recovered, will, if re-injected (say a fortnight after recovery) with a suitable dose of virulent material, not only have the disease again (exhibit tumour and rise of temperature, and appear quiet and off its feed) but may even succumb after several days illness with severe pathological appearances of the lungs and spleen. If the dose be not large it becomes affected with the disease but does not die. Thus, I have re-injected and re-infected the same animals, three, four, and even five times, using every time a larger dose, and administering at length 1–2 cubic centimetres of virulent broth culture. But when this has been done, that is, after five infections, if the final dose be sufficiently large, *e.g.*, 2 cubic centimetres of virulent recent broth culture, the animal may succumb after several days illness. From this it appears that though by repeated injections the animals acquire a slight amount of resistance, this is not sufficient to protect them from being again and again infected with the disease. They do, however, become by repeated injection less susceptible to a fatal attack.

It is unnecessary in illustration to describe all the experiments made in this direction; one will suffice:—

A guinea-pig (guinea-pig No. 1 of my note-book) was injected subcutaneously in the groin on January 25th, with about $\frac{1}{20}$th of a

recent (7 days old) gelatine culture of the plague bacillus, derived from the heart's blood of a guinea-pig dead of the typical disease. Next day the animal had slight though distinct inguinal tumour. Forty-eight hours after injection the animal was quiet and a little off its feed, the inguinal tumour being slightly increased in size. Seventy-two hours after injection the animal was still quiet and did not feed well; the tumour was stationary. Ninety-six hours after injection the animal was again fairly lively and fed well; tumour stationary, firm. On the seventh day the animal seemed quite normal; just a trace of the tumour could be felt, but this had disappeared by February 5th.

On February 12th, this animal (guinea-pig No. 1) was *re-injected* with a dose of heart's blood of a guinea-pig dead of the disease. A similar dose of the blood proved fatal to a control guinea-pig.

Next day, February 13th, this guinea-pig had distinct tumour at the seat of inoculation, was quiet, and did not feed well.

February 15th. Tumour still distinct; the animal was still quiet and did not feed well. Fluid withdrawn from the tumour yielded on cultivation a pure crop of plague bacilli. These, on injection, into another guinea-pig proved of normal virulence.

February 17th. Tumour increased in size; the animal was fairly lively and fed better.

February 24th. Big swelling, the size of a pigeon's egg, in the groin; but the animal was lively and fed well.

On March 3rd, guinea-pig No. 1 was *re-injected* in the other groin with $\frac{1}{4}$ of a cubic centimetre of virulent broth culture of plague bacillus; a dose which was fatal to a control guinea-pig in the usual time.

March 4th. The animal was quiet, did not feed, and had a small tumour at the site of the last inoculation.

March 5th. The animal a little livelier and feeding better; tumour not enlarged. Fluid was withdrawn from the tumour and used for cultivation. It produced a pure crop of plague bacilli, and these, on injection into a guinea-pig, produced the disease followed by death in the typical way.

March 6th. The condition was practically same, the animal not yet recovered.

March 8th. The animal seemed normal, was lively and fed well; it still had tumour.

On April 14th, the experimented animal (guinea-pig No. 1) being quite normal, and all trace of tumour in both groins having disappeared many days before, was *re-injected* with a mixture of juice of the inguinal lymph gland and of the heart's blood of a guinea-pig dead of the typical disease. A like dose of this mixture produced typical disease, and death in 60 hours in a control animal.

This fourth injection of guinea-pig No. 1 produced in the inguinal region of the inoculated side a rapidly growing tumour, which by the third day had reached the size of a pigeon's egg; but the animal remained lively and fed well.

On the ninth day, the general condition of the animal remaining normal, the tumour, which was still very large, was examined and found to be filled with fluctuating contents; the skin above it, however, was unbroken. After disinfection of the skin, an incision was made into the tumour, and a quantity of sanguineous, thick, grumous, purulent matter was discharged. Examined under the microscope in stained film specimens, this purulent matter contained a very large number of bacilli; many isolated, others in chains and in aggregations. No bacilli were detected within the pus cells. The bacilli, in size, shape, and arrangement, could not be distinguished from the typical plague

bacillus. Cultures made with a trace of the pus on gelatine yielded a large number of colonies. After 48 hours many of these were seen to be liquefying the gelatine, and by this liquefaction the nonliquefying colonies became swamped. Two or three drops of the above purulent matter was injected subcutaneously into the groin of a guinea-pig. The animal remained for three days without tumour, and was lively; but on the fourth day had distinct tumour, and was quiet and off its feed. On the fifth day the tumour had greatly increased, and the animal was distinctly ill. It was killed on this day. On post-mortem examination, the inguinal tumour exuded, when cut into, a large amount of sanguineous fluid; the subcutaneous tissue of the abdomen and chest was swollen and oedematous. The spleen was enlarged and full of greyish nodules. Cultivations and cover glass specimens of the inguinal fluid showed very numerous plague bacilli; the spleen contained relatively few bacilli. About $\frac{1}{4}$ of a cubic centimetre of the inguinal fluid was injected into a fresh guinea-pig, which became affected with and died from typical plague.

From this it appears that a guinea-pig that had been three times injected with living culture of the plague bacillus was still capable of being infected, and that the tumour resulting from a fourth injection yielded, even on the ninth day, living and typical plague bacilli.

(2.) *The Blood-serum of Guinea-pigs subjected to Injection of the Plague Bacillus.*

A number of experiments were made with the object of learning whether the blood of guinea-pigs that had passed through induced plague and had completely recovered, possesses germicidal or immunising property. Of these experiments it is not necessary to give the details of more than two; others yielded the same results.

(1.) A guinea-pig (guinea-pig No. 1 already referred to), injected the first time on January 25th, with a small non-fatal dose of living culture of the plague bacillus, had by February 9th, completely recovered from the injection. On this date—15 days after injection—blood was withdrawn from the ear vein, allowed to clot, and with the serum thus obtained the following experiment was made:—

(*a.*) A control guinea-pig (No. 24) was injected with $\frac{1}{4}$ of a cubic centimetre of an emulsion of a recent gelatine surface culture of the plague bacillus.

(*b.*) Another guinea-pig (No. 26) of about the same weight was injected in the groin with a mixture of $0 \cdot 5$ of a cubic centimetre of this blood serum, and $0 \cdot 5$ of a cubic centimetre of above emulsion.

The result was rather unexpected, inasmuch as both guinea-pigs developed the typical disease. The serum-*plus*-culture guinea-pig, No. 26, was indeed more severely affected than the control animal; it (No. 26) died in 24 hours, whereas the control animal died in 60 hours.

The post-mortem of guinea-pig No. 26 showed very severe disease of the lungs and spleen; and cover glass films and cultures proved that the blood, the lung juice, and the spleen tissue, as also the inguinal tumour, were full of plague bacilli.

(2.) From the same guinea-pig (guinea-pig No. 1), 15 days after its second successful injection and after the animal had become seemingly normal, blood was withdrawn, allowed to clot, and the serum was used for the following experiments:—

(*a.*) A control guinea-pig received subcutaneously 0·25 of a cubic centimetre of virulent living broth culture of the plague bacillus.

(*b.*) A second guinea-pig of about the same weight received subcutaneously 0·25 of a cubic centimetre of the same living broth culture, plus 0·1 of a cubic centimetre of the blood serum.

The control animal died in 48 hours, the culture-*plus*-serum animal died in 52 hours.* In both the symptoms and pathological appearances were typical of plague, and microscopic and cultural examination yielded typical results.

I have made several additional experiments with the blood that was used in the above experiment, injecting subcutaneously into guinea-pigs from 0·10 to 0·25 of a cubic centimetre of the serum, and, 24 hours afterwards, an ordinarily fatal dose of plague culture. The result was the same as if no serum had been injected previously; so that that blood serum injected in fair amount had no immunising power, *i.e.*, did not possess ability to confer passive immunity.

It is quite clear, then, that the blood of a guinea-pig that had passed twice through the typical disease has no germicidal power to speak of—at any rate not 15 days after the infection—against an otherwise fatal dose of culture. And it follows that the blood of a guinea-pig that has passed twice through plague does not, as does the blood of this animal when immunised against cholera or typhoid, contain any appreciable amount of germicidal substances.

(3.) *Injection of Sterilised Cultures of the Plague Bacillus.*

A considerable number of cultures which had been found to be virulent when used in a living state, were thoroughly sterilised by exposing them for about ten minutes to a temperature of 62–65° C. Thus, as regards solid media the copious growth on the slanting surface of the gelatine or the agar was scraped off into sterile bouillon, and the resulting emulsion subjected to the above conditions. Broth cultures were sterilised as such. Both sorts of sterilised material were then used for subcutaneous or for intraperitoneal injection. Of the sterilised emulsion of gelatine or agar cultures, which were very turbid and thick and contained continuous masses of bacilli, considerable quantities were injected, as a rule, about ⅓ to ½ of the scrapings of a culture.

An important fact was soon ascertained in these experiments. It was that not even large doses of the sterilised emulsion of a gelatine or of an agar surface culture, whether injected subcutaneously or intraperitoneally into guinea-pigs, caused any appreciable disease. I have in some instances injected intraperitoneally as a first injection as much as half of a gelatine culture without producing any illness, the animals being next morning seemingly all right. It will be remembered, from previous reports of mine, that some other microbes, *e.g.*, cholera vibrio, Finkler's vibrio, the colon bacillus, the typhoid bacillus, and bacillus prodigiosus, cause acute peritonitis and death if sterilised cultures are injected intraperitoneally in doses considerably smaller than the above; and that other microbes, *e.g.*, sporeless anthrax, the bacillus of fowl cholera, and the diphtheria bacillus, cause no illness if similarly

* Sterile broth culture of the plague bacillus inoculated subcutaneously into the guinea-pig in quantities much larger than the above causes no disease; so that the metabolic products present in the broth culture could not have contributed to the fatal result in this instance.

App. B. No. 7.

On the Bacillus of Plague; by Dr. Klein.

injected in a sterilised state. So far, then, as what I have termed "intracellular" poison is concerned, the plague bacillus is to be classed in the group of microbes to which bacillus anthracis, bacillus of fowl cholera, and bacillus diphtheriæ belong. All four microbes differ essentially in this respect from the vibrio of cholera, the vibrio of Finkler, bacillus prodigiosus, bacillus coli, and the typhoid bacillus.

Similarly sterilised broth culture of the plague bacillus injected, whether intraperitoneally or subcutaneously, in doses of one cubic centimetre (*i.e.*, several times the fatal dose of living broth culture) failed to produce in guinea-pigs any detectable illness.

The next question to be determined was: Whether, as in the case, for instance, of the cholera vibrio, the typhoid bacillus, and the diphtheria bacillus, any appreciable degree of immunity can be produced in, and, as a consequence, germicidal serum obtained from, guinea-pigs, by repeated subcutaneous or intraperitoneal injections of sterilised cultures of the plague bacillus. Accordingly I made a number of experiments in this direction. The results will be understood if I describe the details of a few series only.

Series a.—Three guinea-pigs *a*, *b*, and *c*, were injected, *intraperitoneally*, on January 18th, each with $\frac{2}{3}$ of a gelatine culture of plague bacillus that had been previously sterilised. The animals appeared a little quiet on the evening of the day of injection, but had quite recovered by the following morning.

On January 21st they were again injected, *intraperitoneally*, each receiving about $\frac{1}{3}$ of a sterilised gelatine culture of the bacillus: so that each animal had now received a whole gelatine culture sterilised. The animals were quite lively and normal the following morning.

A fortnight later all three animals were injected, *subcutaneously*, each receiving about $\frac{1}{32}$ of a living gelatine culture. Two days after this injection they were found quiet; they refused food, and each had a tumour in the inguinal region. They all three remained ill for another day; but on the fourth day, while two (*b* and *c*) appeared lively again, the third (*a*) seemed in poor condition and remained so till the sixth day, when it died. The lungs of this animal were found much inflamed, large portions being in a state of hepatisation, with small and large grey nodules and patches. Film specimens made of the lung juice showed dense masses of plague bacilli; and a drop of blood yielded on cultivation innumerable colonies of the bacillus. The other two guinea-pigs (*b*) and (*c*) quite recovered; but considering the very small dose that had been injected in each instance ($\frac{1}{32}$ of a living gelatine culture), it was to be expected that they would recover. For this reason the death of guinea-pig (*a*) is the much more significant; it indicates that by the two previous injections of large doses of sterilised culture no resistance had been produced.

Series b.—In this series three guinea-pigs were injected *subcutaneously* with sterilised gelatine culture of the plague bacillus on four separate occasions, February 22nd, February 24th, February 27th, and March 2nd. The amounts used per animal were $\frac{1}{3}$, $\frac{1}{3}$, $\frac{2}{3}$, and $\frac{2}{3}$ of a culture. In no case was any illness noticed after injection, the animals remained unaffected.

They were then, a fortnight after the last injection, injected *subcutaneously* with living broth culture, each animal receiving $\frac{1}{4}$ of a cubic centimetre. On the third day after this injection all had inguinal tumour, and they were quiet and did not feed well. On the fourth day two had very big tumour, and were still quiet; in the third the tumour had not increased and the animal seemed less quiet. The two former animals died on the ninth day with very pronounced disease of lungs

and spleen; the lung and spleen juices were crowded with the plague bacilli, and the heart's blood yielded innumerable colonies. The third guinea-pig recovered. It appears, then, that the amount of resistance produced by the four *subcutaneous* injections of large doses of sterilised gelatine culture was small; $\frac{1}{4}$ of a cubic centimetre of living virulent broth culture, which killed a control guinea-pig in 48–72 hours, produced fatal result in two animals on the ninth day, only one animal recovering.

Series c.—In this series two guinea-pigs were injected on February 8th, *intraperitoneally*, with sterilised (virulent) broth culture, each animal receiving one cubic centimetre. The animals remained unaffected. On February 11th they were reinjected, again *intraperitoneally*, each with one cubic centimetre of the same sterilised broth culture. They remained unaffected. On February 14th they were again injected in the same way and with the same amount of the same sterilised broth culture; and on February 17th the operation was repeated on precisely the same lines.

A fortnight later both animals were injected, *subcutaneously*, with living broth culture, each animal receiving $\frac{1}{4}$ of a cubic centimetre.

On the third day both animals were found quiet, and both died at the end of 72 hours. No inguinal tumour was found in either animal, but there was copious exudation of peritoneal fluid crowded with living plague bacilli. The blood also contained living bacilli in large numbers. Thus, the intraperitoneal injection of no less than four cubic centimetres of sterilised broth culture per animal did not have the effect of furnishing them with any appreciable amount of resistance; a control guinea-pig injected subcutaneously with the same dose ($\frac{1}{4}$ cubic centimetre) of the same living broth culture died at the same time and showed similar peritonitis with crowds of the bacilli in the exudation, but without inguinal tumour.

Series d.—Three guinea-pigs were four times injected, *subcutaneonsly*, with sterilised (virulent) broth culture, each animal receiving on each occasion 1 cubic centimetre. The first injection was made on March 3rd, the second on March 4th, the third on March 5th, and the fourth on March 10th. In no instance was any disease hereby produced.

After a week—the animals being normal—they were injected a fifth time, on this occasion with at least a fourfold fatal dose of living broth culture. The result was interesting: All three animals on the third day had tumour, and were a little quiet and off their feed. On the fourth day their tumours had increased, but the animals seemed lively and fed well. On the fifth day they were in the same state. By the seventh day their tumours had opened on the surface and were suppurating. On the eighth day one animal was found dead, with pronounced disease of the lungs, spleen, and peritoneum. In the other two animals suppuration had ceased and the skin had completely healed up by the eighteenth day.

One month after the last (fifth) injection, these two surviving guinea-pigs were *subcutaneously* re-injected with virulent lung juice, the dose used being sufficient to kill a control guinea-pig within 60 hours. Both guinea-pigs showed next day inguinal tumour and were quiet and off their feed. This condition, with increase of tumour, remained on the third day; but on the fourth day the animals were again lively and fed well, although they still had inguinal tumour.

From this experiment it is seen that these two guinea-pigs, which had received by subcutaneous injection a total of four cubic centimetres of sterilised broth culture, though they survived a fifth injection of at

App. B. No. 7.

On the Bacillus of Plague; by Dr. Klein.

least a fourfold fatal dose of living broth culture, nevertheless reacted on a further and sixth injection with virulent lung juice. It is, however, clear that a certain resistance had been produced by the preparation of these animals with sterilised broth culture.

This harmonises with the observations of Roux and Yersin, who similarly found the immunisation of guinea-pig by sterilised cultures an extremely slow and difficult process.

So, too, is immunisation of the guinea-pig with non-fatal doses of living culture. In the first place, I have shown that such animals are capable of repeated re-infection with living virus after they have quite recovered from the previous attack, and in the second place I have shown that the blood of animals that had passed through the disease once or twice has no immunising power worth speaking of. I fail, therefore, to understand the results obtained by Kolle (Deutsche Med. Woch. No. 10). He states that after he had injected four ginea-pigs subcutaneously with small doses of sterilised culture (sterilised at 68° C.) of the plague bacillus, these animals were found 16 days after insusceptible to infection by subcutaneous injection of virulent cultures.

Lustig and Galeotti (Br. Med. Journal, April 24, 1897, p. 1027) describe experiments, in which they succeeded in extracting from large amounts of culture material (surface agar cultures of plague bacillus) nucleo-proteids which, when used in certain doses, produced toxic effects, and which in small doses acted as vaccine. "The animals vaccinated "with small doses on one occasion only, or with the minimum killing "dose divided into two or three times and injected subcutaneously "at intervals of two days, show the utmost indifference to the "subcutaneous and intraperitoneal injections of a great quantity of "virulent culture." It is, however, necessary to note that the amounts of the ultimate extracts which these authors used for producing toxic effects (death in a few hours), and the amounts also that they used for protective purposes, would correspond to enormous masses of bacilli, a quantity of material such as in experiments with actual cultures cannot be employed in practice except by administration of a very large number of injections.

E.—Experiments on Rabbits with Plague Bacillus.

Rabbits are normally less susceptible to plague infection than guinea-pigs. Rabbits can be injected subcutaneously with considerable doses of living culture, of blood, of lung juice, or of spleen tissue derived from a guinea-pig dead of the disease, without showing any marked illness. They exhibit only a slight temporary swelling about the seat of inoculation. In some cases the swelling leads to suppuration and ulceration, which, however, soon completely heals up again. The following experiments illustrate this resistance of rabbits:—

1. Two rabbits (half-grown) were injected on February 26th, *subcutaneously*, each with about $\frac{1}{6}$ of a living agar culture of the plague bacillus. No result.

2. Both were re-injected on March 2nd, *subcutaneously*, with $\frac{1}{4}$ of a cubic centimetre of living virulent broth culture of the bacillus. Forty-eight hours later one only showed slight swelling; both animals were lively and fed well.

3. Both were re-injected, each with $\frac{1}{4}$ of a cubic centimetre of virulent broth culture, on March 5th. The animals remained well and had no tumour.

4. They were re-injected, each with 1 cubic centimetre of virulent broth culture, on March 13th. Forty-eight hours afterwards one only had distinct swelling; both were lively and fed well. Five days later the tumour of the above animal was suppurating, but it remained otherwise well.

On April 8th, *i.e.*, 26 days subsequent to the last injection, blood was taken from one of these rabbits, allowed to clot, and its serum used for the following experiments:—

(*a.*) One (control) guinea-pig received $\frac{1}{6}$ of a gelatine culture of plague bacillus *intraperitoneally.*

(*b.*) One (control) guinea-pig received a like dose of gelatine culture *subcutaneously.*

(*c.*) One guinea-pig received a mixture of a similar dose of gelatine culture and 0·5 of a cubic centimetre of the above blood serum, *intrapertioneally.*

(*d.*) One guinea-pig received a like mixture of the plague bacillus culture and 0·5 cubic centimetre of blood serum, *subcutaneously.*

The result was that all four animals became equally affected with the disease; and they died between the fourth and fifth day of illness, with the characteristic symptoms and pathological appearances. Guinea-pig (*a*) and guinea-pig (*c*) had each copious viscid peritoneal exudation crowded with plague bacilli.

Thus, 0·5 of a cubic centimetre of rabbit serum had no germicidal or immunising action on a dose of plague bacili which, seeing that it did not in control animals cause death until between the fourth and fifth day, could not be considered a large one.

That the above half-grown rabbits, notwithstanding their previous four injections, were still capable of reacting on further injection was proved as follows:—

5. Both were re-injected on April 8th, each with 2 cubic centimetres of virulent broth culture. Forty-eight hours after both animals showed tumour, but were otherwise lively and fed well.

6. On April 14th they were re-injected with 1 cubic centimetre of lung juice and juice of the inguinal tumour of a guinea-pig dead of the disease. Forty-eight hours after both showed distinct tumour, which was still present and distinct on April 22nd, *i.e.*, eight days after.

On April 30th, *i.e.*, 16 days after the last injection, blood was drawn from one of these rabbits, allowed to clot, and with the serum thus obtained the following experiments were made:—

(*a.*) A guinea-pig was injected *subcutaneously* (for control) with a minimal fatal dose of living broth culture of the plague bacillus—0·1 of a cubic centimetre.

(*b.*) Another guinea-pig of same weight was injected *subcutaneously* with a mixture of a like dose of same broth culture and 0·25 of a cubic centimetre of the above rabbit serum.

Both animals behaved in exactly the same way. Next day they had inguinal tumour, which subsequently increased considerably in size. On the third day they were both quiet and off their feed; guinea-pig (*a*) more so than guinea-pig (*b*). Both died, one (*a*) on the 6th, the other (*b*) on the seventh day, with the typical symptoms of plague infection.

In addition to this, another experiment was made in order to ascertain whether the blood serum of the above rabbit possessed any

protective (passive immunising) action. For this purpose two guinea-pigs were injected *subcutaneously*, each with 0·5 of a cubic centimetre of the above serum alone. Forty-eight hours later each animal received, also *subcutaneously*, 0·25 of a cubic centimetre of living virulent broth culture of the plague bacillus; a third unprepared guinea-pig receiving, for purposes of control, a like dose of the same broth culture. The result was the same in all three animals; death in 72 hours with the typical appearances of plague infection.

PLATE XII.

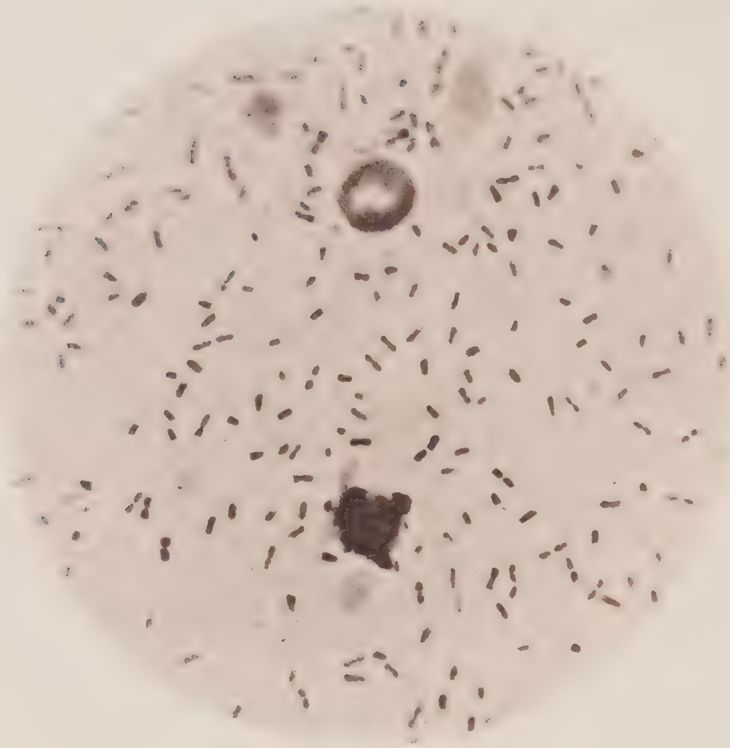


Fig. 22.

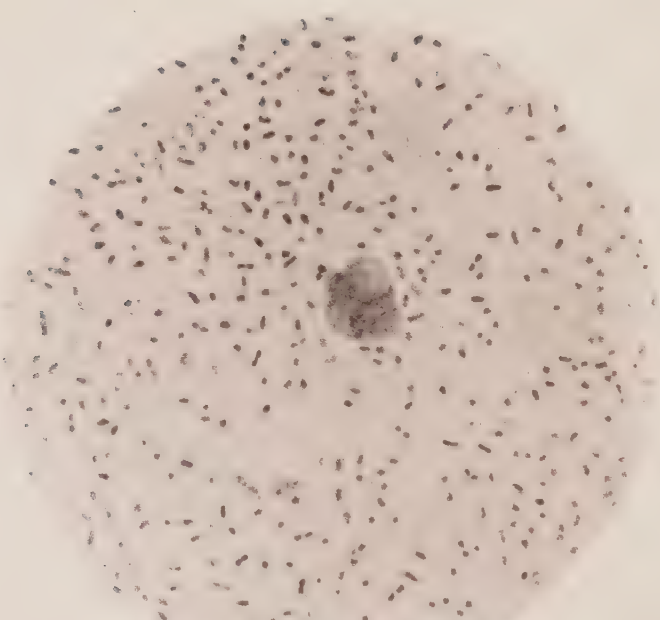


Fig. 23.

ORIENTAL OR BUBONIC PLAGUE.

PLATE XII.

FIG. 22.

Plague bacilli: Reproduced from a photograph of a film specimen of fluid from the inguinal bubo of a person attacked by plague in Hong Kong.

[Magnifying power, 1,000.]

FIG. 23.

Plague bacilli: Reproduced from a photograph of a film specimen of fluid from the inguinal bubo of a guinea-pig which died after inoculation with plague material.

[Magnifying power, 1,000.]

ORIENTAL OR BUBONIC PLAGUE.

PLATE XIII.

FIG. 24.

Plague bacilli among blood corpuscles: Reproduced from a photograph of a film specimen of the heart-blood of a guinea-pig which died after inoculation with plague material.

[Magnifying power, 1,000.]

FIG. 25.

Plague bacilli in the spleen: Reproduced from a photograph of a film specimen of the spleen juice of a guinea-pig which died after inoculation of plague material.

[Magnifying power, 1,000.]

PLATE XIII.

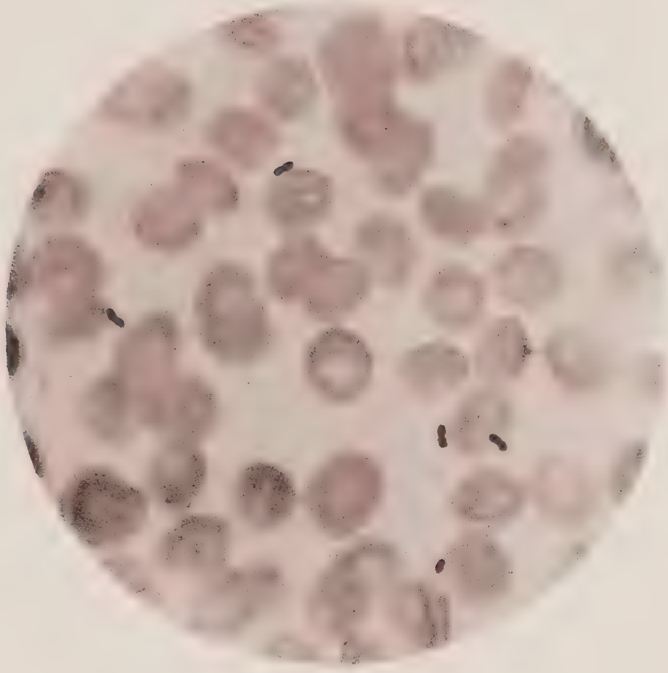


FIG. 24.

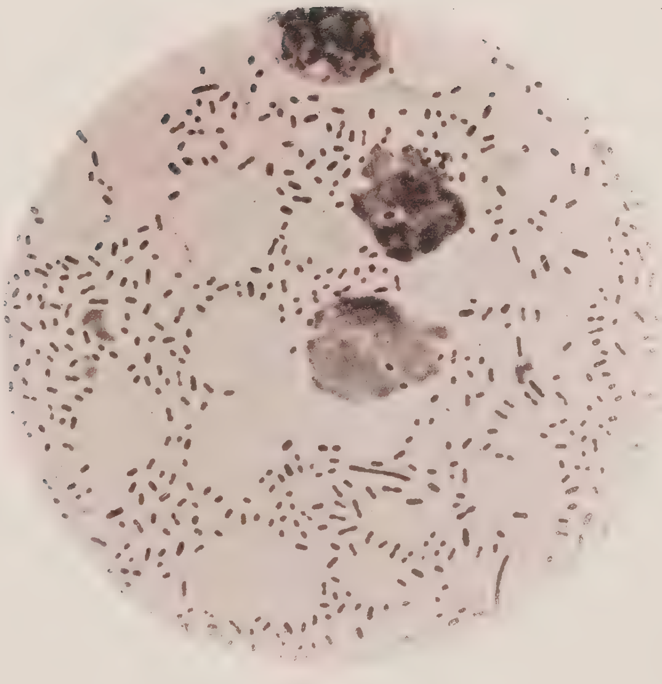


FIG. 25.

PLATE XIV.

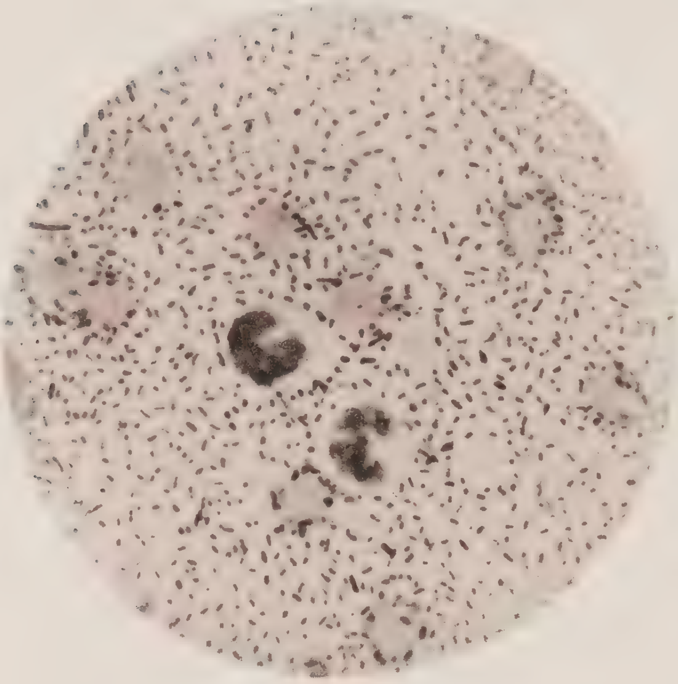


FIG. 26.

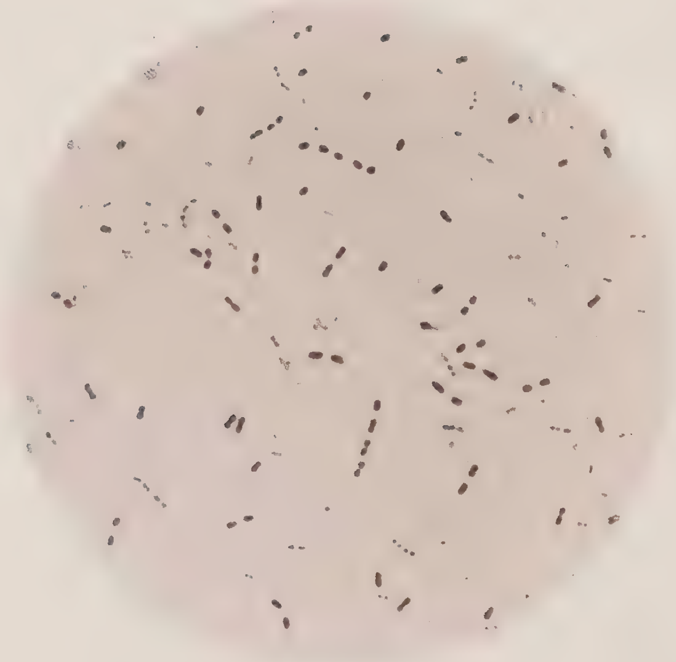


FIG. 27.

ORIENTAL OR BUBONIC PLAGUE.

PLATE XIV.

FIG. 26.

Plague bacilli in lymph gland: Reproduced from a photograph of a film specimen of juice from a pelvic lymph of a guinea-pig, which died after inoculation of plague material.

[Magnifying power, 1,000.]

FIG. 27.

Plague bacilli from the peritoneum: Reproduced from a photograph of a film specimen of peritoneal fluid of a guinea-pig, which died after intraperitoneal injection of culture of plague bacillus. The microbe is here seen in chains.

[Magnifying power, 1,000.]

ORIENTAL OR BUBONIC PLAGUE.

PLATE XV.

FIG. 28.

Plague bacilli: A colony of the microbe on gelatine 24 hours old.

[Magnifying power, 1,000.]

FIG. 29.

Colonies of plague bacillus on the surface of gelatine, after 24 hours. The majority of these colonies, which are angular in shape, are made up of minute rods: to the left of the figure are two colonies which are atypical in that they comprise plague bacilli that are filamentous.

[Magnifying power, 80.]

PLATE XV.

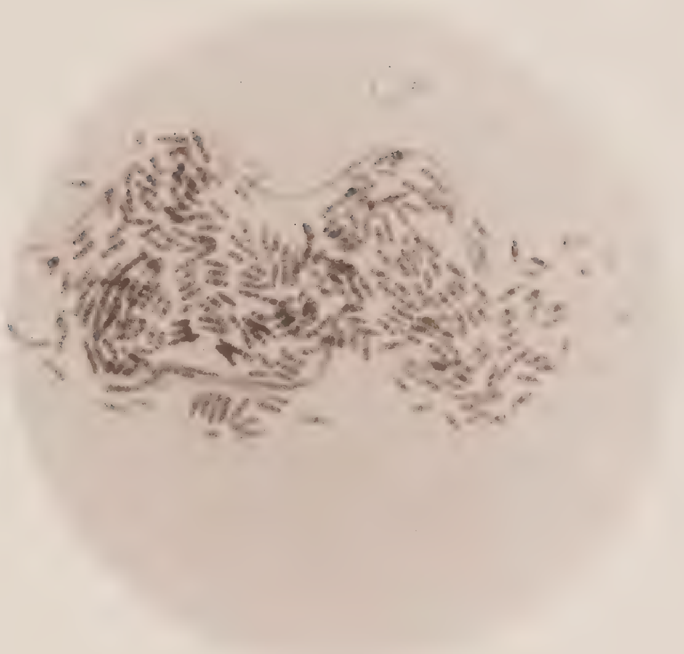


FIG. 28.

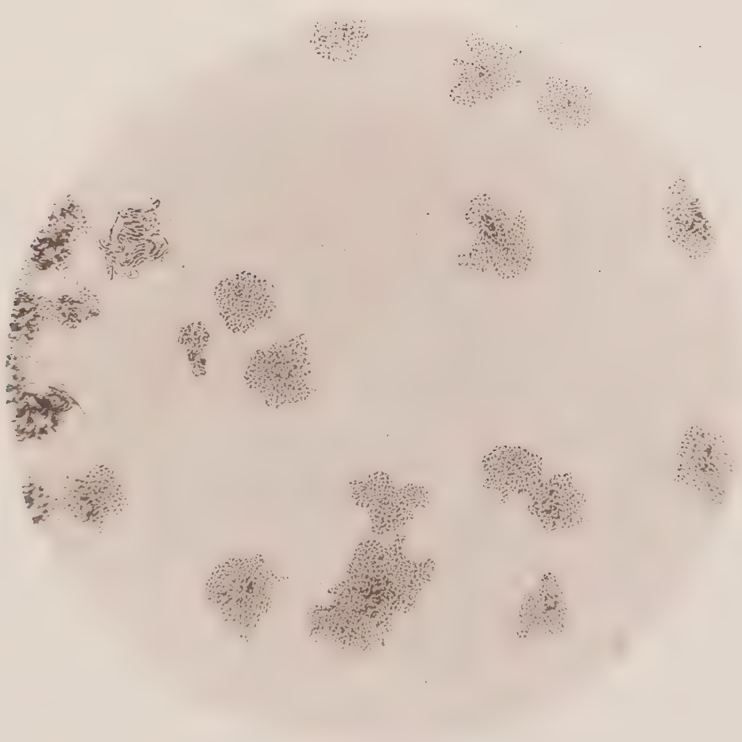


FIG. 29.

PLATE XVI.

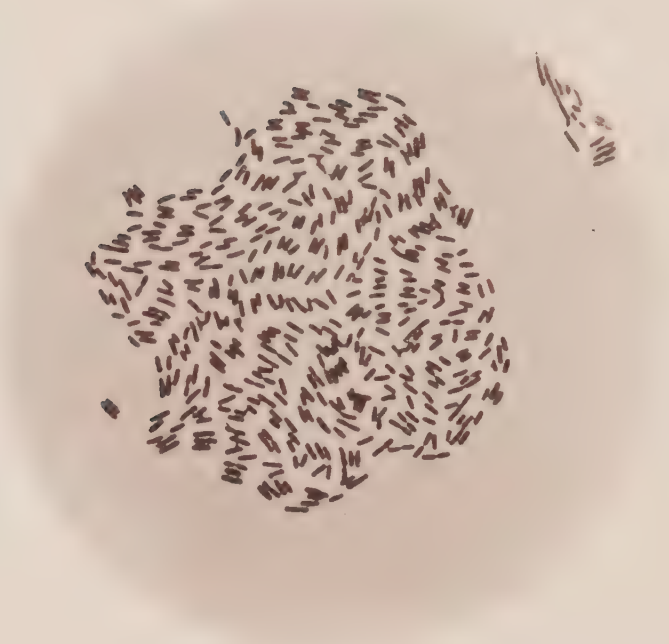


FIG. 30.

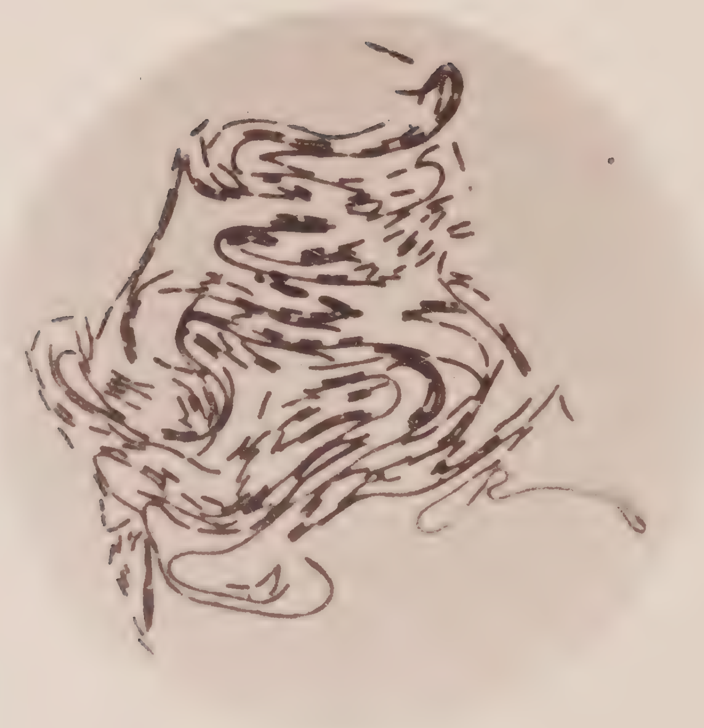


FIG. 31.

ORIENTAL OR BUBONIC PLAGUE.

PLATE XVI.

FIG. 30.

Colony of typical plague bacilli from the specimen depicted in Fig. 29.

[Magnifying power, 800.]

FIG. 31.

Colony of a typical (filamentous) plague bacilli from the specimen depicted in Fig. 29.

[Magnifying power, 800.]

ORIENTAL OR BUBONIC PLAGUE.

PLATE XVII.

FIG. 32.

Two adjacent colonies of plague bacillus: The one (upper) containing typical, the other (lower) containing atypical (filamentous) bacilli.

[Magnifying power, 500.]

FIG. 33.

Colonies of plague bacillus in plate culture on gelatine, after four days' incubation.

[Natural size.]

PLATE XVII.

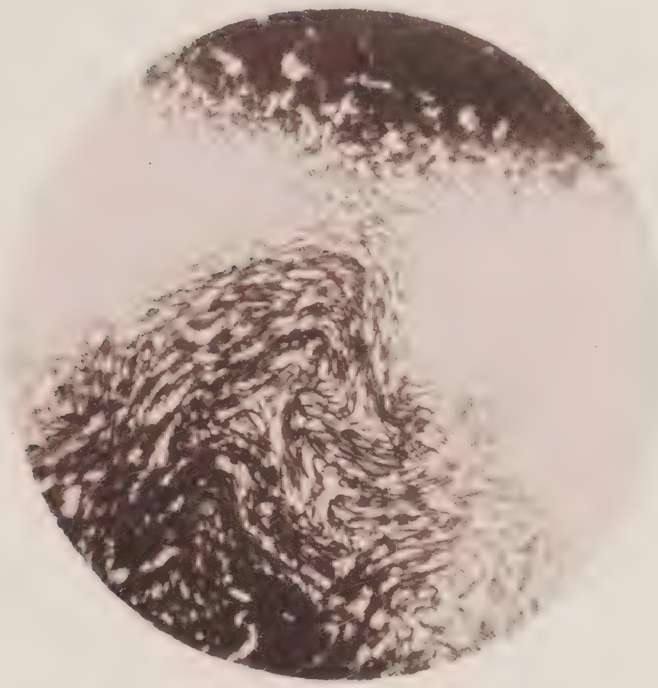


Fig. 32.

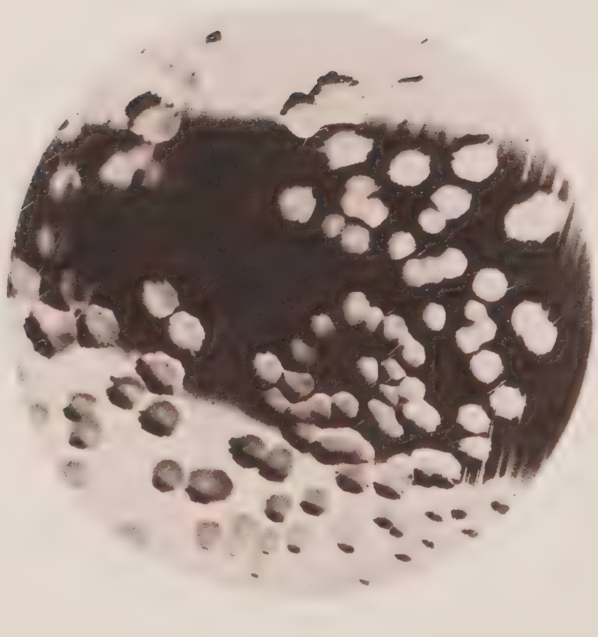


Fig. 33.